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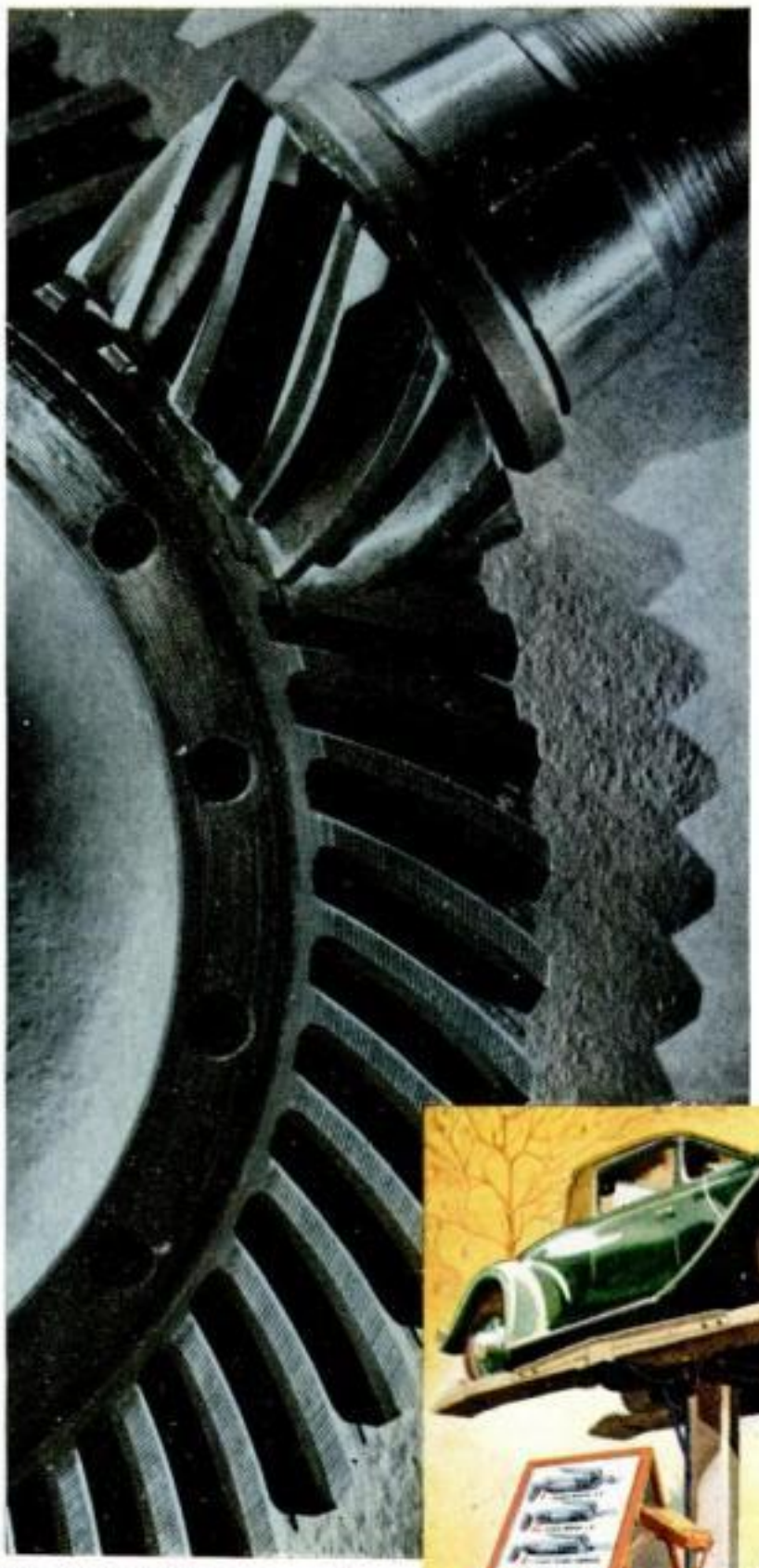

The helical drive-gear, used on the great majority of cars today, is a special form of bevel gear with the teeth set at an angle across the face. It must have an exceptionally adhesive lubricant.

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"That ad . . . 'Look at All Three' . . . seemed to be a sporting proposition . . . so we looked at the other two low-priced cars."

"Then we saw the Plymouth. As an artist, the first thing that struck me, naturally, was its beautiful design."

"My wife just couldn't keep from getting behind the wheel. We agreed that Floating Power surely is smooth!"

"Every time we go out, we like it better and better. It's a thrill to drive it! Yes, sir, I'm glad we looked at All Three."

"If you ask me, Plymouth is America's next Number One Car"

TALK to any Plymouth owner! Ask him why he bought his car, and how he likes it! You'll find the same enthusiasm everywhere you go. The same honest conviction that Plymouth offers most for the money.

Edward Trumbull's case is typical of thousands. Like the rest of us, he wanted to be sure of getting his money's worth. That's why "Look at All Three" appealed to him. It sounded fair. So he looked, studied, compared . . . then bought a Plymouth.

When people buy a car as carefully as Edward Trumbull did, and keep on raving about it, it means something. Word-of-mouth is the strongest kind of advertising. Happy owners are a car's best salesmen. And Plymouth owners *are* happy! Lots of them are saying—"Plymouth is America's Next Number One Car!"

Talk to them about Plymouth's Floating Power engine mountings . . . Hydraulic Brakes . . . 70 h.p. engine . . . safety-steel body . . . Then ask for a Floating Power ride!

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POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 122 · NUMBER 3
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

TABLE of CONTENTS for MARCH, 1933

March, 1933. Vol. 122, No. 3. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

(Continued on page 4)

To Men who are Eager to get back into the Stock Market

Before you put a dollar into the stock market, you should read this message. It tells about a plan which safeguards your money—a plan which has been followed by nearly fifty thousand people without the loss of a penny in spite of the depression—a plan which, as long as it is in force, makes sure that if other investments go wrong, you and your family will still have a guaranteed sum of money to fall back on.

HOW THE PLAN WORKS

This plan was perfected by the Phoenix Mutual, an 81-year-old insurance company which has been helping men and women to end money worries since 1851. In the panel at the right are listed some of the things which the plan enables you to provide.

Here is how the plan works: You select from this list the things you want and then you pay for them in installments of only a few dollars a month. One of the great advantages of the plan is that it begins to operate the minute you pay your first small installment. Even though you should become totally disabled and unable to make another payment, you would not need to worry, because your installments would be paid by us out of our special disability fund.

Isn't that better than putting all your money into the stock market? This plan offers everything you would expect from other forms of investment, plus the absolute, guaranteed safety of your money.

Send for the twenty-four-page booklet which tells all about the plan, how it works and what it can do for you. Simply fill in and mail the coupon below, and the booklet will be mailed to you without cost or obligation. Do not delay. Do not put it off. Mail the coupon now.

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3. Money to leave your home clear of debt.
4. Money for emergencies.
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6. An income for your daughter, independent of her husband.
7. An income for yourself in case you are disabled.
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POPULAR SCIENCE MONTHLY for MARCH, 1933

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HEALTH AND HYGIENE

MODELS

NEW DEVICES FOR THE HOME

UNUSUAL FACTS AND IDEAS

NEW PROCESSES AND INVENTIONS

FOR THE HOME OWNER

IDEAS FOR THE HANDY MAN

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Miracle Worker, AGE 8

His little hands hold the instrument tightly; his small, confident voice speaks eagerly into the mouthpiece. And as simply as that, he talks to his friend who lives around the corner, or to his Granny in a distant city . . . achievements which, not so many years ago, would have seemed miraculous.

These miracles he takes as a matter of course, in the stride of his carefree days. You yourself probably accept the telephone just as casually. Seldom do you realize what extraordinary powers it gives you. You use it daily for a dozen different purposes. For friendly chats. For business calls. To save steps, time and trouble. To be many places, do many things, visit many people, without so much as moving from the living room of your home or the desk in your office.

At this very moment, somewhere, your voice would be the most welcome music in the world. Some one would find happiness in knowing where you are and how you are. Some one would say gratefully, sincerely—"I was wishing you'd call."

From among more than seventeen million telephones in this country, the very one you want will be connected quickly and efficiently with the telephone in your home or office.

Your telephone is the modern miracle which permits you to range where you will—talk with whom you will. It is yours to use at any hour of the day or night.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

WHERE Amateurs *Have No Standing*

By LEON MEADOW, *Financial Editor*

GOING home on the train the other night, I couldn't help overhearing a conversation between two men in the seat ahead of me. One of them looked up from the financial section of the newspaper he had been reading and said to the other, "If I had the money I'd get in on some of that Case Threshing Stock. I've got a hunch you're going to see a big rise in it within the next two weeks."

"Why do that?" his friend replied. "I've got a hot tip on Coca-Cola—from some one who knows."

After they left the train, I set to thinking about the distorted vision that apparently sane men exercise in some affairs. Here were two men who, from all appearances, were evidently well-to-do and moderately successful, and yet their talk on investments wouldn't do credit to a sixteen year old boy.

I suppose it is one of the peculiar twists in a human being's make-up that accounts for the fact that intelligent people will lavish great attention and caution on minor things, and yet undertake many important operations without so much as a thought to proper investigation or expert advice. The woman who will spend an entire day selecting the right pair of gloves, may enter into a life companionship without knowing the man she accepts as her husband. The man who is fanatically particular about the ties or shoes he buys, will often purchase a home because he likes the special closet built for housing his golf clubs, or for some equally trivial reason.

In no field, however, is an unbalanced set of values so prevalent as in the purchase or sale of securities. Yet, there is hardly an undertaking which requires so much general and specific knowledge as does the problem of investing. Because any man or woman who has the money can go to a broker or a bank and order whatever stocks and bonds they want, many have come to believe that they can entrust themselves with the exchange of their capital for securities.

TO THEM, perhaps, it is the same as putting to sea in a frail sail-boat, and without any experience in navigation, simply because they have enough money to buy the boat. Psychologically, it isn't hard to understand. Man's very ignorance alone is enough to make him overlook the difficulties of any given venture. Viewed from land, nothing seems easier than sailing a boat. When you're on the ground, an airplane landing doesn't seem to take particular skill. In a similar manner, and until one learns to the contrary, buying stocks and bonds and holding them until they go higher seems like child's play. A review of the last two years should settle that delusion.

The price, value and safety of income of any security is determined by countless direct and indirect factors. The disturbed conditions of things today is evidence enough of that statement, although it must be admitted that some of the influences now are more pronounced than usual. Yet, these influences, in one form or another, are always with us as actual or potential factors that affect our investments. International, national and local finance and politics, scientific progress, social changes and developments, style trends, spending habits and popular tastes, international trade, interest and discount rates, balance of payments between nations, seasonal weather, crop results, migration, competitive conditions in industry, managements and a veritable host of other factors, big and small, play their separate parts in the valuation of any security, as viewed from an investment standpoint.

IN OTHER words, judicious investment is a problem that demands of any man as much time as he would ordinarily give his own business. Any man who attempts to do justice to both, must do so by compromise—and then one or the other, and most likely both, are bound to suffer. For investing not only requires a man's full time in following all factors mentioned, but it also demands that he be an expert in quickly selecting all the pertinent facts and figures from the various and involved financial and statistical services, trade and newspapers, government reports, etc. Even then, granting that he finds the time and facilities for doing all this, it will be of very little use to him unless he has a broad background of experience in analyzing financial statements, economic reports and treatises, in determining the trends and meaning of markets, and in drawing the proper conclusions, a faculty which often calls for unusual vision and a highly developed sense of values.

Furthermore, a man who possessed all these qualities would find it impossible, if only from a standpoint of time alone, to cover the entire field, and it would be necessary for him to engage qualified specialists for appraising values in the main groups of securities, such as railroads, public *(Continued on page 7)*

WHERE AMATEURS HAVE NO STANDING

(Continued from page 6)

utilities, manufacturing and mining, municipal and foreign government bonds, etc.

All of which makes it pretty evident that the average citizen, without the knowledge of a professional analyst, cannot be expected to handle his investments with any degree of efficiency and success. The financial world is no place for amateurs and no one seems to have realized this so thoroughly as a great many wealthy and successful business men, or so-called "big investors." These men would not think of entering upon any investment program without proper assistance and advice, *even though, as a rule, they undoubtedly have more investment experience and better access to sources of information than the average small investor.* And yet, obviously, the small investor stands in far greater need of well-balanced, experienced advice than his more fortunate big brother.

THAT being so, what makes so many investors, including some of our more well-to-do ones, turn away from the idea of adequate investment help? Here are three reasons why:

1. It is human nature to be independent, and to do without the aid of others whereever it *seems* unnecessary.

2. The expense of a fee for investment advice is looked upon as an expense item and, therefore, as a loss.

3. Ignorance of how or whom to select as a counsel, and fear that even the adviser's judgment may prove incorrect.

Let's take up these three points in order and see if it's possible to iron out the wrinkles. First, independence is an excellent thing, but not particularly practical when exercised at the expense of efficiency and success. The character of investments often spells the difference between financial security and loss of everything, the difference between comfort and poverty. It is therefore too serious a thing to play or experiment with, too dangerous a charge in the hands of an amateur. The sheer luck of a few who have gained *temporary* success in handling their own investments should be a warning to all others who remember the old saying about rules and their exceptions. One might as well disregard the services of proper and qualified medical or surgical attention because there are cases when laymen did the right thing in emergencies. Judges will tell you of men who successfully defended their own cases in court, but for everyone who did, ninety-nine, who dispensed with lawyers' services, lost the decision. Be independent about decisions you know are qualified by experience or knowledge to make, but don't overlook or belittle the help of those who know on affairs outside of your field.

Second, the expense is comparatively small. On an investment fund of $50.000 the fee generally runs no higher than $250. a year, and is proportionately lower or higher according *(Continued on page 8)*

WHERE AMATEURS HAVE NO STANDING

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to the size of the fund. This represents a fee of one-half of one per cent, or a sacrifice of less than one-tenth of the 5½% which may be taken as the average return on an investment portfolio. We use the word "sacrifice," but it should not be looked upon as that. Experienced advice, which is instrumental in preventing losses, is cheap at any price, and all the more valuable when it helps create capital and income profits which may more than offset the fee by several times. Many a man who thought he could save investment counsel fees by handling his own investments, has since learned the meaning of "penny wise, pound foolish."

Third, investment counsel, being the product of human intelligence and ability, is liable to error. It would be foolish to think otherwise. But that is a poor reason for condemning *all* investment advice as useless. The fact that lawyers, doctors and engineers sometimes make mistakes hardly makes their service the more dispensable. People who would build their own skyscrapers and automobiles because architects and manufacturers make mistakes, are fit subjects for the insane asylum. As for the man who insists on guaranteed perfection, he will at last come to a point where outside advice or aid cannot be had, and in the meantime he will have done himself irreparable harm.

THE selection of the right investment counsel can be made by applying a rule which also applies to many other things. Look only for the best, since a generally uniform basis of fees puts all investment counsel services on a parallel where expense is concerned.

The successful and reliable investment counsel can be located in the same way one finds a good printer or tailor—that is, by referring to their clients. The good ones will rest their case on the word of their customers. Most probably they will be serving an old, satisfied clientele, and will not depend on a large or frequent turnover of subscribers. If they advertise or sell their services through salesmen, they may be aggressive and convincing in their claims, but they will not set themselves up as cure-alls or state that they have made millionaires overnight out of small investors. They will emphasize strongly the need and desirability of a properly balanced portfolio of holdings; they will stress conservative methods of investing. They will discourage gambling, and present the long-term viewpoint rather than the day-to-day fluctuations of the security market.

There is no magic formula for selecting the right investment counsel. It rests almost entirely with a person's mental ability and strength of decision to detect and withstand the exaggerations of high-powered salesmanship. Your own common sense must in the end determine the sincerity and truth of facts, as presented. Those are the only rules for choosing an investment counsel worthy of your trust and of the nominal fee you pay for guarding and protecting your *(Continued on page 9)*

WHERE AMATEURS HAVE NO STANDING

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money by means of his experience and investment talent, abilities which are gained over a long period of years in the hard school of investment training.

There is one specific guide-post that everyone can follow in choosing the proper investment counsel. Whomever is selected, let it be a man or an organization with nothing to sell beside their services and experience. Men or firms interested directly or indirectly in the sale or purchase of specific securities are too apt to recommend what they want to acquire or dispose of at advantageous prices. By the very workings of human nature, these people cannot be unbiased. Stick to the man with an advisory service only. One who is not, in addition, a security dealer, a stock manipulator or anything else which might cause him to be prejudiced.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worthwhile investment as well as a form of protection. Provident Mutual Life Insurance Company, of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

"You Can Have An Income As Long As You Live," a booklet describing simply and clearly how the Annuity can be used to provide a guaranteed income for life. A copy will be sent on request to Inquiry Bureau, John Hancock Mutual Life Insurance Company, 197 Clarendon Street, Boston, Massachusetts.

Our Readers Say

Spring This on Your Friends And Maybe You'll Lose Them

HERE'S one that's been bothering me for a long time. Some of your scientific readers probably know the answer. Suppose we take a compression spring, like the valve spring on an automobile, compress it, and then bind it with wire so as to hold it in compression. Then we drop it into a container of strong acid. Taking for granted, of course, that the acid will eat both the compressed spring and the binding wire at the same uniform rate, what happens to the energy stored in the spring when the whole business has dissolved? The law of conservation of energy, they tell me, says that energy can neither be created or destroyed. It has to go some place. What happened to it? Is it transformed into heat? —H.J.P., Baltimore, Md.

Magnetic Field Accounts for Your Jumping Ring

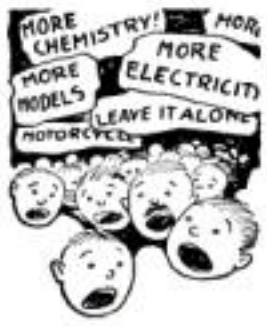
HERE is my explanation of the jumping ring problem recently submitted. The size of wire or number of turns will make little difference. The ring will jump away because of magnetic action. Two like poles will repel each other. The ring of wire when placed near the coil with the current flowing through it, will have induced in it, by transformer action, a current opposite in direction to that in the primary coil. This current will produce a magnetic field around the coil. The ring, being on the iron core, will then be thrown away by the action between these two magnetic fields set up by the two currents.—R.G., Utica, N. Y.

See Page 68 for New Ideas in Square-Knot Work

IN A recent issue of the POPULAR SCIENCE MONTHLY I was very interested in the article about knotted belts. I learned how to make them and have made about a dozen of them so would like to learn some new patterns. In the article it said if one were interested in finding out more about them to write to you. So will you please send me any information you might have to give.—L.T., Honolulu, T. H.

More of This, More of That; Now Chemistry's at Bat

IN A recent issue of POPULAR SCIENCE MONTHLY, I read a letter from one of your Australian readers who wrote that he thought there should be more chemical news in your magazine. I write this to say that I agree with him and to ask you to stick to your name of POPULAR SCIENCE MONTHLY.—C.A.R., Woodmere, N. Y.



If the Poison Gas Fails, the Bombs Will Get You

TELL me, is it true, as some chemist recently said, that "skyscraper cities" have little to fear from wartime attacks with poison gas? According to this chemist all gases so far used lose their effectiveness thirty feet from the ground. Rooms on the upper floors of tall buildings would thus serve as safe refuges from a gas attack. That's all very fine, and I suppose it ought to make us city slickers feel perfectly safe. But what about bombs? A few of those dropped here and there might make a towering gas refuge a mighty uncomfortable place. What? Will some one please tell me how to escape *that* danger?—C.A.S., Chicago, Ill.

Wanted: Colored Lights for His Tamed Fish

I AM putting this problem before you in the hope of receiving, from your vast experience, the desired information. I am quite an amateur at artistic ornamental iron work, having learned this art from my father who was a real artist in this line. Now I am making for my little old home a novel type aquarium and flower stand combined. It is partly completed but the idea struck me to incorporate, more for originality than for anything else, (you know, I crave originality) a scheme of changing colored lights under the bowl. I am in hopes you can help me either with definite instructions or by directing me to the proper parties who will tell me how to arrange and install the lights. Can I count on you? I am also greatly interested in all things ornamental, especially if they are of forged metal.—G.F.M., Mariners Harbor, N. Y.

All Right, Mr. Wailes, What Can You Do About This?

CAN you or any of your readers give me the necessary information for making a chemical garden of about twelve different varieties of chemical growths? Water glass is the main ingredient, as far as I know. By the way, I'm starting a chemistry laboratory and therefore agree with all readers who say your magazine needs nothing but more chemistry articles.—H.L., Phillipsburg, N. J.

That Expanding Soap Bubble Gets Caught in Calculus

IF A.P.B. of East Lynn, Mass., expects his soap bubble problem to be solved without a knowledge of calculus he is quite right in saying that many long winter evenings may be whiled away in doing so. I have found the answer by a method which I believe cannot be beaten for brevity, but if there is any other way, shorter or longer, I should like to know it. My answer is 0.00708 inches per second or 0.425 inches per minute. What is yours? I can prove my answer if necessary. Give us something hard, you mathematical wizards!—R.E.E., Baltimore, Md.

One Extra Rib May Mean More Blubber for Eskimos

I SEE by the papers that Eskimos are getting an extra rib. An examination of 200 Eskimo skeletons, it is said, showed a good many of them with twenty-five ribs instead of the normal twenty-four. The discovery is regarded as proof that evolution is still going on among this race. I wish some of your bright readers would tell me what good this rib will be after they all get it. Will they be stronger, able to eat more fat, and less likely to smack down their wives and beat up the children? Is it possible this rib stuff is the result of prohibition? That might be a good angle from which to attack the problem.—Q.O., Cleveland, Ohio.

Cutting Precious Stones Looks Like a Good Job

I AM desirous of securing information about the cutting and polishing of precious stones, such as agates, agatized wood, or opals. I would like to learn where machinery for such work can be secured and what the approximate cost will be. Can any reader tell me if there is a market for such stones after they are polished and whether a man of sixty might safely undertake such a line of work? I realize that this is rather a large order. Possibly somebody can refer me to something already published that will answer my questions. I am a regular subscriber and prize the paper very highly. It is a tonic when I am over-wrought with my regular line of duties.—(Rev.) J.F.W., Boise, Idaho.

Here's a Problem That Is Just the Bee's Knees

YOU evolutionists might ponder this one: When a bee goes into a flower, its breathing apparatus becomes plugged up. To open it again, the bee has brushes on its knees which he uses after he comes out of the flower. Organic evolution says that as new needs arise, new organs are developed to take care of them. In the case of the bee, this process seems to fall

down. Isn't it apparent that the first bee ever born would not have discovered the need for brushes until after it had gone into the flower and its breathing apparatus had become plugged? It would then be too late for organic evolution to come to its rescue. So what?—R.K., Detroit, Mich.

Jig Saw Puzzles That You All Can Make

As a subscriber of your magazine for several years, and enjoying it very much, I have often wondered what use I could make of the very interesting cover on each month's issue. At last I have thought of something that seems excellent to me. Cut the cover from the book and glue it upon a three-ply veneer board. Then cut out pieces of various sizes, shapes, and designs with a jig saw. Thus the covers can be made into interesting and instructive jig saw puzzles and many hours of pleasure may be had by every member of the family in assembling them. Won't this idea interest your readers?—C.F.B., Floral Park N. Y.

Lost on The Trail of Energy, He Yells to You for Help

My mind is on this question of matter and energy and it has become so mixed up in my head that I am calling on you and your readers to help me out. They tell me that matter cannot be created or destroyed and the same thing holds true for energy. But in the case of the radio-active elements, a certain portion of the matter contained in them goes off in a state that is neither matter nor energy. Why is this not destroying matter? Why not give us readers of your magazine a tip on the relation of energy to matter so we can stay straight on this question of creating and destroying things? I would really enjoy such an article. I think that you have the best magazine of its kind on the market.—M.O.M., Nashville, Tenn.

He's Tried Them All And Your Magazine Leads

I have been receiving your magazine for several years and I want to tell you that I enjoy it very much and look forward each month to its arrival. I have read practically all the magazines of this type and can say without any hesitation that Popular Science Monthly surpasses them all. I would very much like to secure working drawings for a quilting frame. These are not listed but I write in case you may have them or expect to have them in the near future.—C.H.B., Sewickley, Pa.

For Inventors Only: Three Big Ideas

Are you still keeping your famous book, "What's Wanted," with a list of needed inventions? If so, here are a few that I'd like to see added: 1. A tobacco humidor that actually keeps tobacco humid. 2. A bed that makes itself (I almost solved this myself—but it's still in the paper stage!) 3. A Sunday newspaper with sufficient force of cohesion to keep its sections from scattering to the remotest corners of a house.—P.R., New York City.

Helpful Hints in the Study of the Speed of Light

In a recent issue of Popular Science Monthly John L. Coontz describes the efforts to determine the exact speed of light. He says that there is a variation of fifteen miles per second from the old determination and that the reason is unknown. He says nothing about the possibility that this variation may be due to the fact that the old determination was obtained from experiments in air, while the new was from experiments in a vacuum, or a near vacuum. From the article it would seem that this has been overlooked. With the equipment described, it could be determined whether this variation is due to the vacuum. Could that be possible? I have written this letter on the supposition that all of this may have been overlooked, and if so, you can call it to the attention of the experimenters who could then make needed corrections.—L.L.L., Waterloo, Ia.

Surgeons and Their Work Win His Admiration

Having finished the remarkable article on "How Modern Surgeons Conquer Fatal Germs" and connected it with "Triumphs of Surgery," I am filled with admiring wonder. I wish to approve to the fullest extent the statement made by H.L.S., that "it's great stuff," and I too will eat up every article Dr. Damrau writes. In addition, I would like to say that every respectable doctor and surgeon of the world should be looked upon by his fellow citizens as one who has endured many trials and hardships in his desire to aid mankind.—W.F.D.G., Oregon, Mo.

Aspirin Works Miracle in a Goldfish Bowl

A joke—so we thought! But it was a lifesaver for the goldfish. We returned home after a week-end away and found one of our goldfish floating inertly in the bowl, apparently dead. I picked it up to dispose of it but the kid sister stopped me. She wanted to try an experiment. She took the fish, and placed it in a small jar of water in which an aspirin had been dissolved. The next morning the fish was swimming around as healthy as ever. And he is still very much alive. Moral: If your goldfish seemingly dies, give it an aspirin! It may come back to life.—C.J.C., Buffalo, N. Y.

At Least One Spider Web Blew Across Wide Gap

Perhaps M.O.M.'s question regarding a spider web, in a recent issue of Popular Science Monthly may find an answer in an experience of mine. When a boy, living near a mountain in Pennsylvania, I went up to the top where a large tree stood in the open, about one hundred feet from the edge of the forest and lay down in the shade. As I lay there looking up I saw, glistening about thirty feet above me, a long spider web, a single strand. A light breeze was blowing from the tree toward the forest; as I watched, it grew longer and soon a puff of wind took the loose end high in the air and as it came down it rested on a limb of one of the trees. Boy fashion, I hunted for a stick to throw up against the glistening thread. I did not find one so I returned to look at the thread and to my astonishment there was a spider creeping along on the under side of it. I watched him until he reached the tree to which the cord was attached. I am now ninety years old and this happened long ago but I do not know what became of the spider.—(Dr.) H.A.D., Madison, Wisc.

Follow Our Articles And You'll Learn How

Your articles dealing with the necessary equipment for building a model railroad have been very helpful to me. Following your ideas, I now have a fairly good railroad layout. But now I'm stuck with the most important feature of the entire system missing. I have no signal system. I hope you will explain to me how to make my trains stop automatically.—M.Y., Brooklyn, N. Y.

"More Than 100 Per Cent" Strikes Him As Too Much

Under the title "Explosions Drive Giant Turbines," I noticed the statement, "by the use of explosion boilers it is possible to extract more than 100 per cent of the heat that the fuel theoretically contains." I object. Even if the exhaust gases are discharged at a temperature lower than the surrounding air, that, in my opinion, does not imply an efficiency of even 100 per cent, to say nothing of an efficiency of more than 100 per cent. The matter above absolute zero, which is 273° below zero on the Centigrade scale and 466° below zero on the Farenheit scale, contains heat. Now, to extract more than 100 per cent of the heat the fuel contains, the exhaust gases would have to be expelled at a temperature below absolute zero, which is impossible. Scientists have not been able to reach absolute zero in the laboratory; they have, I might add, reached a temperature of .71° above absolute zero, as I recall it. In concluding my objections, I will say the statement in the article also violates the first law of thermodynamics, which simply is one of the many applications of the conservation of energy—energy cannot be created or destroyed, but only transformed or converted.—T.H.R., Gardner, Mass.

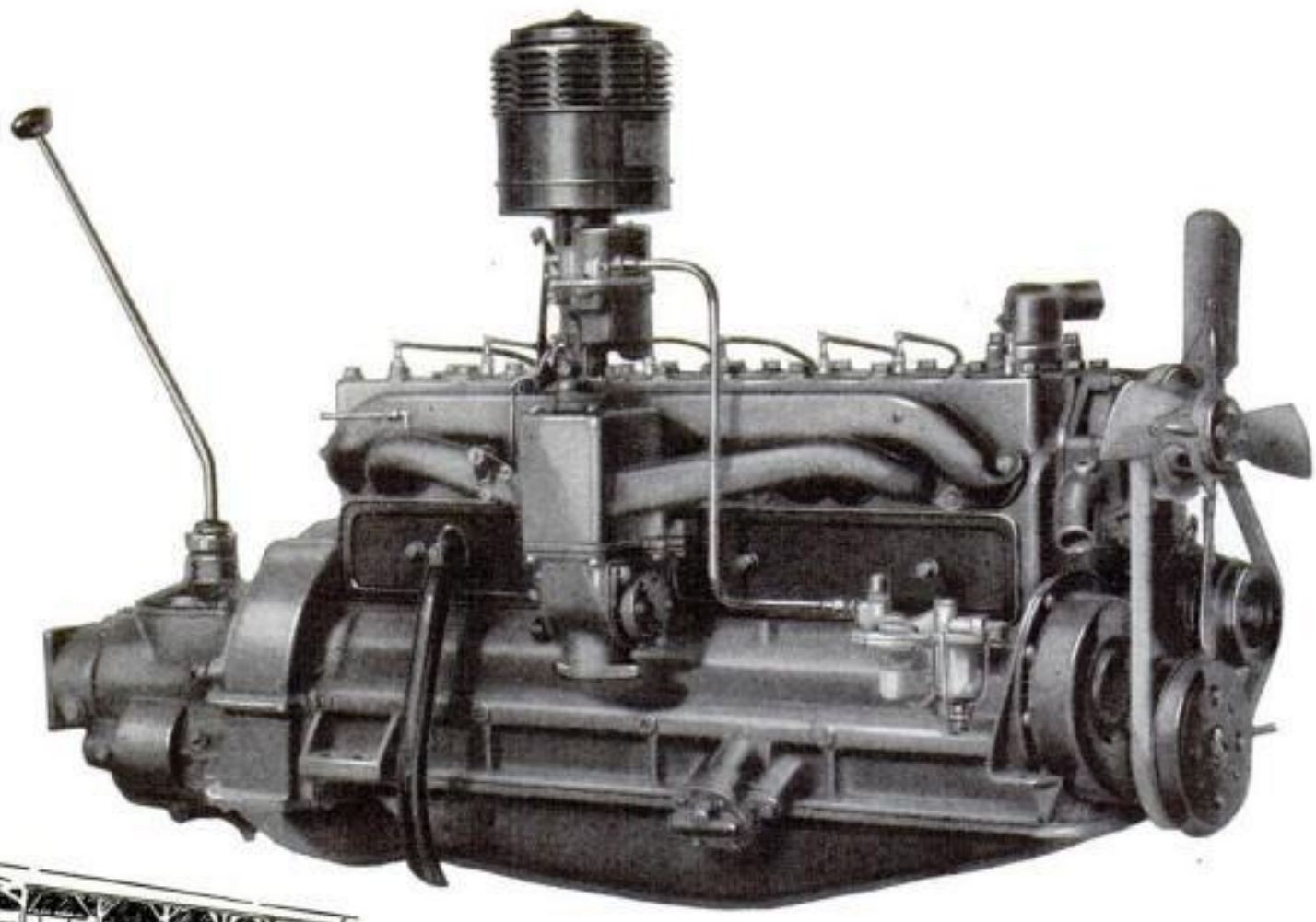
Measure Them as You Will, They'll Run Just as Fast

Why should the managers of athletic affairs have more brains than the rest of us? While we struggle along with feet, yards, and rods, the Amateur Athletic Union has adopted the metric system of measurement for all future track and field events that it sanctions. Now American athletes can be rated directly in comparison with those of other countries. The metric system, simple to learn and use, is anathema to Americans! Is that sensible?—A.L.B., Springfield, Mo.

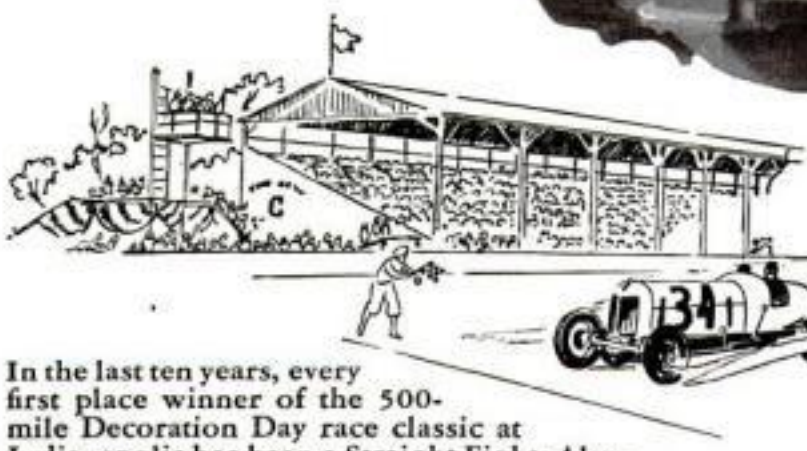
How About "You Win" and "Here's The Ten I Borrowed?"

Picking out the ten most beautiful words in the English language seems to be becoming a new fad for dictionary lovers. Why not a list drawn exclusively from the field of science and mechanics? Here are my choices: Dynamo, momentum, crystal, beryllium, diatom, fluid, turbine, capillarity, incandescent, electrolysis. Do I hear any other nominations?—H.R.F., Paterson, N. J.

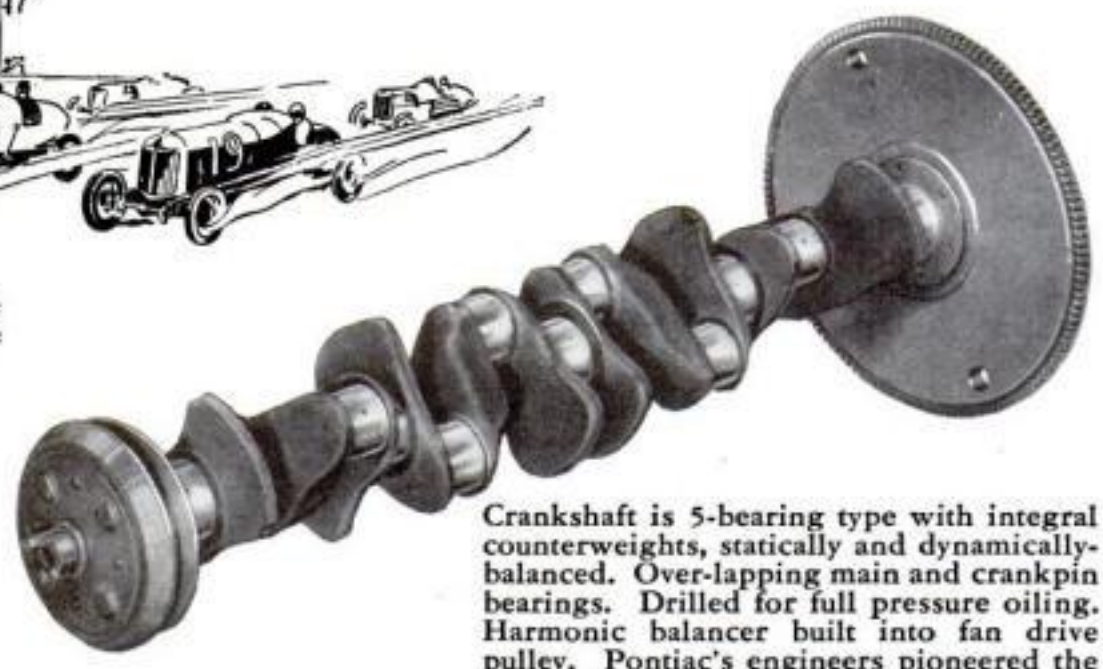
Pontiac *perfects the* Economy STRAIGHT EIGHT



The new Pontiac's power plant is a 77-horsepower Straight 8, mounted on 5 encased rubber cushionings. L-head type. Bore, 3 5/16. Stroke, 3½. Compression ratio, 5.7 to 1 Std. Full force feed lubrication. Down-draft carburetor and manifold.



In the last ten years, every first place winner of the 500-mile Decoration Day race classic at Indianapolis has been a Straight Eight. Also, 29 of the 30 who finished 1-2-3 over this period, have been Straight Eights. This is the most impressive record ever made by any single type of car.



Crankshaft is 5-bearing type with integral counterweights, statically and dynamically-balanced. Over-lapping main and crankpin bearings. Drilled for full pressure oiling. Harmonic balancer built into fan drive pulley. Pontiac's engineers pioneered the harmonic balancer; have used it seven years.

Electro-plating of the piston skirt permits close fit in cylinder bore, cuts down breaking-in period and prolongs life of piston. Pin has snug press fit in one piston pin boss and is retained in place by locking screw. Opposite end of pin slotted, with light press fit in boss. All pistons machined to uniform weight within ⅛ ounce; pins case-hardened and ground to .0002-inch tolerance.

YOU men interested in things mechanical know that economy is more than just a matter of low first cost and easy gas and oil consumption. It's also—and mostly—a matter of long life and freedom from servicing expense. The less strain there is on each and every part of the engine, the less chance there is of wear. With eight cylinders Pontiac produces 77 horsepower with a third less strain on each part than if this power were developed in a Six. A speed of 78 miles an hour is developed. This Straight 8 engine is designed and engineered to give a maximum of service-free operation—and to consume a minimum of fuel. See the big, low-price Pontiac Economy Straight 8—a General Motors value—at the nearest dealer's showroom. Examine it carefully. And if you want still more information, write to Pontiac, General Motors Corp., Detroit, Mich., for literature. No obligation. Just mention this magazine.

POPULAR SCIENCE
MONTHLY
March 1933 Vol. 122, No. 3
RAYMOND J. BROWN, *Editor*
· FOUNDED 1872 ·
SIXTY-FIRST YEAR

Riding the Night Patrol

From station WPEG, this announcer, Edward Barth, sends out warnings to the radio cars. At top of page, the men of Sixty-five and a precinct car attack a gang

WITH THE Radio Police

By EDWIN TEALE

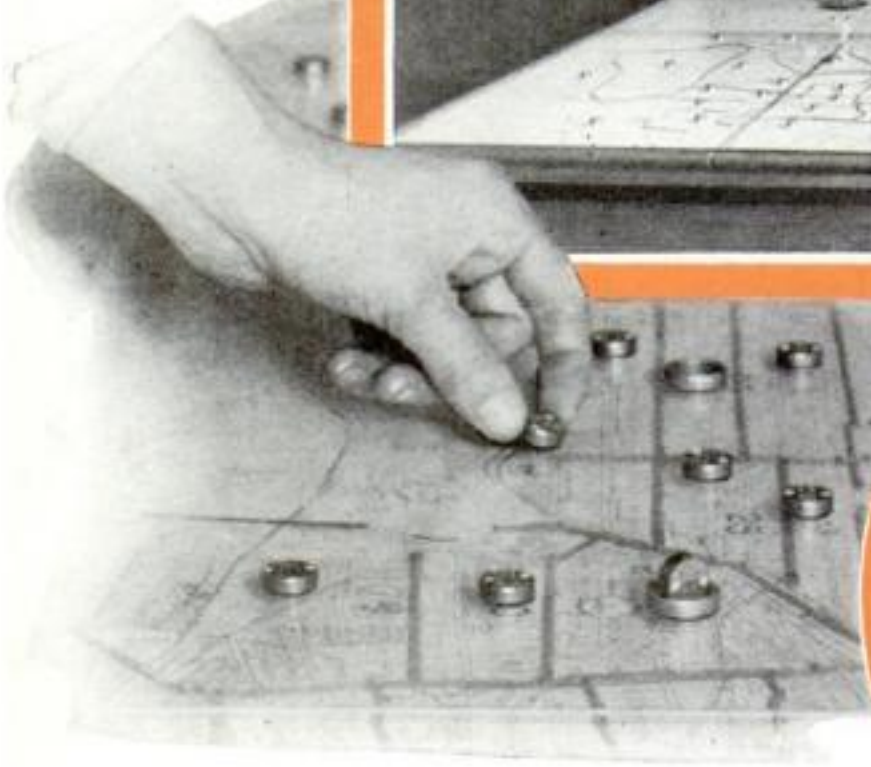
RED, blue, green, the reflections of neon signs race across the polished hood of Cruiser Car Number 65. Private cars swerve to the curb. Crowds flash past. Lighted windows blur and streak together. Cross-street traffic stops as the wail of the siren announces that the night radio patrol is making a run.

For eight thrill-packed hours, one night recently, I rode on radio patrol in the heart of New York City. First-hand, I saw the amazing precision with which this newest machine functions in fighting crime.

We went in a big gray car, listed on the police rolls as Sixty-five. It looks like a rich man's limousine, but under its soft cushions are bullet-proof vests and tear-gas bombs. Over the back of the front seat is a stubby-barreled shotgun, loaded with steel slugs. In a rack on the rear floor is a special battery-run searchlight with a beam that reaches a quarter of a mile. It is used to pick out burglars fleeing over rooftops

KEEPING TABS ON THE CARS

On a big map of the city in the radio station, brass markers, each numbered, are shifted to indicate the position of each car, black side up when the car is on a run and white side up when it is available for a call. At the right, photo shows map and markers and below a close-up of markers being moved



Men from radio cars take no chances on weapons thugs may have concealed but, as in this photo, a search is always made

at night to escape the pursuing officers.

As we rolled along, Patrick Dolan, the detective in charge, introduced me to the others, William Kennedy, crack driver, Frank Waldron, pencil in hand, keeping the record of radio calls on a yellow pad; Bernard Salamone, expert with the slug-gun. Courteous, efficient, heavy-shouldered, Dolan has been on the New York force nineteen years and his companions are picked men who have ridden radio patrol since it was established early last year.

Over our heads, the steady metallic crackle of static comes from a gold-colored loudspeaker, the size of a dinner plate, set in the ceiling. Above it, hidden in the roof of the car, are fifteen square feet of copper mesh, forming the aerial. The set is permanently tuned in on 122.5 meters, the wave length of the three New York police broadcasting stations: WPEG, in Manhattan, WPEE, in Brooklyn, and WPEF, in the Bronx.

Suddenly the static is drowned out by the sustained, ear-piercing note of the 1000-cycle attention call of the New York station. Then a metallic voice:

"Calling cars 507, 561, 1080. Go to Sixth Avenue and West Eighth. Code Signal 31. Station WPEG."

Waldron winds down the window and listens. Far away, above the purr of our engine, we hear the rising wail of three sirens as the radio cars converge on the corner indicated.

"There they roll," says Dolan and Waldron closes the window.

To avoid delays in transmitting instructions, code numbers are employed to indicate the nature of the crime. Thus, 32 means investigate suspicious persons; 31, arrest for felony, dangerous persons, be cautious; and 30, the "dynamite call," indicates a holdup, burglary, shooting, or murder. Every run on the New York Radio Patrol means a major crime or the possibility of one.

The only exception to that rule, of which I heard, occurred under dramatic circumstances. A famous surgeon, the night before my ride, was wanted to perform an emergency operation. No one knew where he was, except that he was riding somewhere in the city in his automobile. The number of the machine was flashed from WPEG. In fifteen minutes, Sixty-five spotted the car and the surgeon was speeding to the hospital.

Five square miles of teeming city life comprise the hunting territory of our car. To the men beside me, as we wind in and out of dark side streets, almost every block recalls some crime in which their car has figured. They are grim, strange tales of a world that comes to life while the city sleeps.

Here a negro, shot through the chest, ran across the street and fell dead in the doorway of an undertaking parlor. There a gangster was found in the gutter with

HERE is the first authentic story of the work done by the radio cars of a big city. Through the courtesy of the Police Commissioner of New York, the author spent a night in one of the big cars gathering the facts that make this one of the most remarkable articles of the year

two pennies lying beside him, tossed down as a final gesture of contempt by his slayer. Up there, where a dim light burns in a dingy house, an old woman was mysteriously strangled, four nights before. In a single week, not long ago, Cruiser Car Sixty-five cleaned up five stickups, three burglaries, and two murders, arriving at the scene of the crime in one case less than a minute after the alarm went on the air.

Reception is best along the waterfront. We catch faint broadcasts going out to radio cars in other cities, in Indianapolis, Ind., Detroit, Mich., Milwaukee, Wisc. We hear a stuttering dot-and-dash message from a short-wave set at sea. But, when a local call goes on the air, it drowns out everything else.

We are leaning forward to catch a faint broadcast to an Indianapolis car, when:

"B-e-e-e-e-p! Calling cars 1007, 1005, *65*. Four persons in a blue sedan with a New Jersey license parked between Tenth and Eleventh Avenues on Fifty-sixth Street. Be careful. *They may have guns.* Signal 31."

In front, Waldron's pencil scratches across the yellow pad. Beside me, Dolan says, "All right, Bill. Let's roll."

The big car speeds up. Kennedy presses the black button that throws the siren into action. We are on a straight run of more than twenty blocks, past dark warehouses, staring crowds, traffic huddled at the curb.

We roar through red lights at forty miles an hour. Then, near the end of the run, the siren stops. We are slowing down. Sixty-five slides to a stop, and we jump out ready for any emergency.

Two other radio cars, small blue-green two-seaters, are already there. In the district covered by Sixty-five, there are a dozen of these precinct cars, known to the service as "Dolly Sisters." Most of the 300 machines of the New York radio fleet are such precinct cars. Less than two dozen are big ace cruiser cars, each manned by four detectives. In the race to be first on the spot, the Dolly Sisters usually win, having smaller territories to patrol.

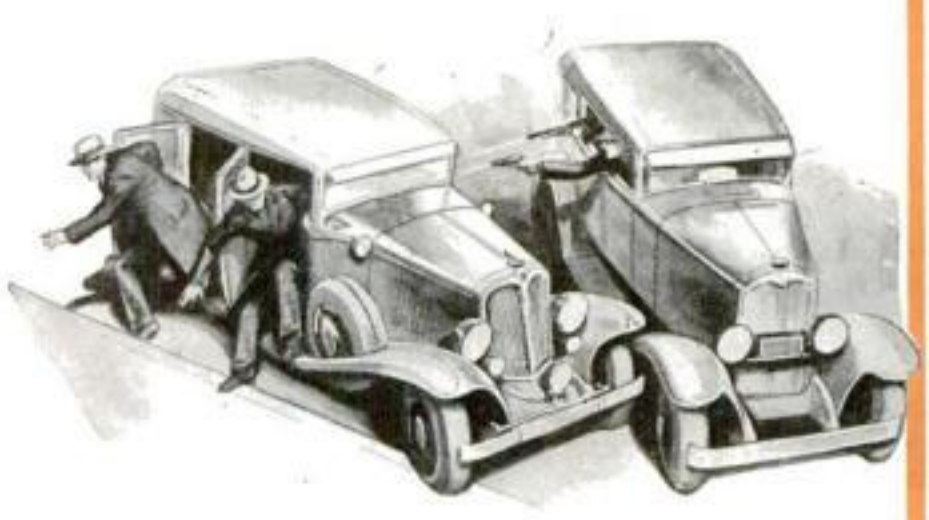
Three men and a woman are climbing out of the blue sedan. A suspicious neighbor phoned the police when he saw them sitting in the car for an hour watching the apartment house across the street. Their story is that they are waiting for the janitor to come home. The woman explains she has a fortune in twenty American banks but can't get a dollar out. She believes the janitor, whom she knew "in the old country," can help her. Just then, the janitor arrives. He takes the detective aside and explains the woman is an old friend, not quite right in her mind, but entirely harmless. Dolan phones his report back to the broadcasting station. Then he climbs into the car shaking his head.

"Join the police and meet queer people," he says.

As we swing slowly north the hands of a huge electric clock point to 8:15. Both local and out-of-town calls are speeding up. All over the country, crime is rearing its head. The beeps come in rapid succession. Burglars are on the roof of a store in Staten Island, across New York Bay. An insane man with a blackjack, is chasing his wife. There is a race riot in Harlem, a stickup in the Ghetto. Every five or ten minutes, local flashes send the cars shuttling back and forth from one part of the city to another.

The busiest time of day for the radio patrol is between eight in the evening and three in the morning. Nearly half of the 100 calls a day go on the air during those seven hours. The quietest time is from four to eight A. M. Sundays and Mondays are the quietest days. But toward evening on sweltering summer Sundays, things pick up. Citizens reach a high point of jumpiness then and the radio cars are kept on the run hunting imaginary burglars and solving crimes that never happen. The big days of the week are Fridays and Saturdays, payroll days when holdups are likely. However, when it rains, there is a drop in the number of stickups. Crime that rides on rubber tires doesn't relish slippery pavements.

Left, Frank Waldron of Sixty-five's crew, makes note on his yellow pad of the details of an alarm message from the Central station. Below, the rear seat of the car in which the author rode, showing the riot gun, tear bombs and also the big, powerful emergency flashlight



Sliding noiselessly abreast of a suspicious machine, the police car cuts in at a sharp angle ahead of it, forcing it to stop or run into the curb. A metal plate, bearing the word "Police" is shown

Our loudspeaker is going into action in rapid spurts as we head east and then turn south. I can visualize the scene back at WPEG: the jingling telephones, the flickering dials, the slap of heavy relays, the rows of glowing tubes. I can picture Edward Barth, announcer, flipping up the tiny black lever that sounds the attention note and then speaking rapidly into the microphone; Joseph Murtha, green eyeshade cocked on his forehead, jotting down the record of every broadcast in a big black book labeled "Radio Patrol Blotter," Charles Hilkemeier, bending above the glass-topped dispatcher's desk, turning over brass markers each time the cars are sent on a run.

For seven hours, the night before, I had

(Continued on page 103)

• BIRTH CONTROL

Restore Wasted

By Andrew R. Boone

TWO weeks before pollen began to fly, a young tree scientist climbed high into the branches of a vigorous Western Yellow pine. At his waist hung a hundred small bags. Over the topmost pinnacle he slipped the first bag, tying it carefully so he could see the blossom through the oblong celluloid window.

Down the tree he worked, quickly fastening the sacks over other blossoms until he had bagged the entire tree. Then on to other trees, climbing and bagging until many trees looked as though they were wearing ten thousand tiny nightcaps.

"What," I asked, "is the idea of that?"

At the Institute of Forest Genetics, fifty miles east of Sacramento, Calif., and in nearby forests, men were doing queer things. Some bagged pine trees. Others sat at low tables with adding machines, calculating the growth of tiny seedlings. Still others were in the field, obtaining cores of grown trees, searching for hardy parents from which to reproduce their young under scientific control and the most painstaking observation.

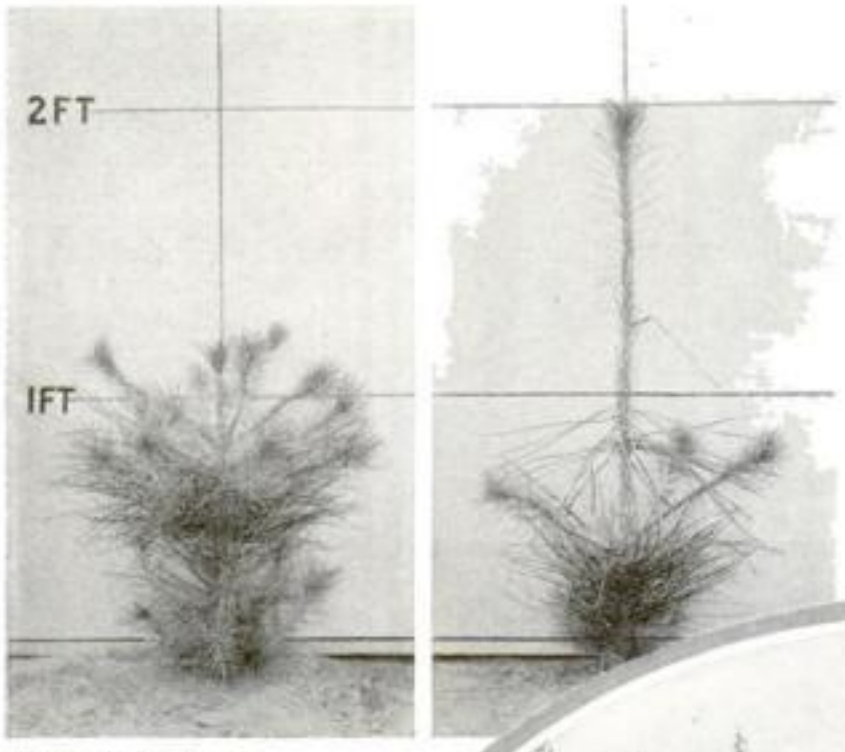
The idea, as Lloyd Austin, Director of the Institute, explained, is simple: They're developing trees that will grow eighty feet tall and to a diameter of sixteen inches in twenty-five years, instead of the fifty to sixty-five years now required; producing stock for forests that will be hard, strong-fibered, nearly disease proof, knotless. And the bagging of pine trees is an important step in the process.

"During the flowering season," Austin told me, "the air in a pine forest may be literally filled with yellow pollen from the male flowers or catkins. Hundreds of trees will be represented in the golden pollen on a windy day. We want to control pollination both as to the male and the female parent. For the female, bagging does the trick; for it keeps out pollen and enables us to inject it on the day the flower opens.

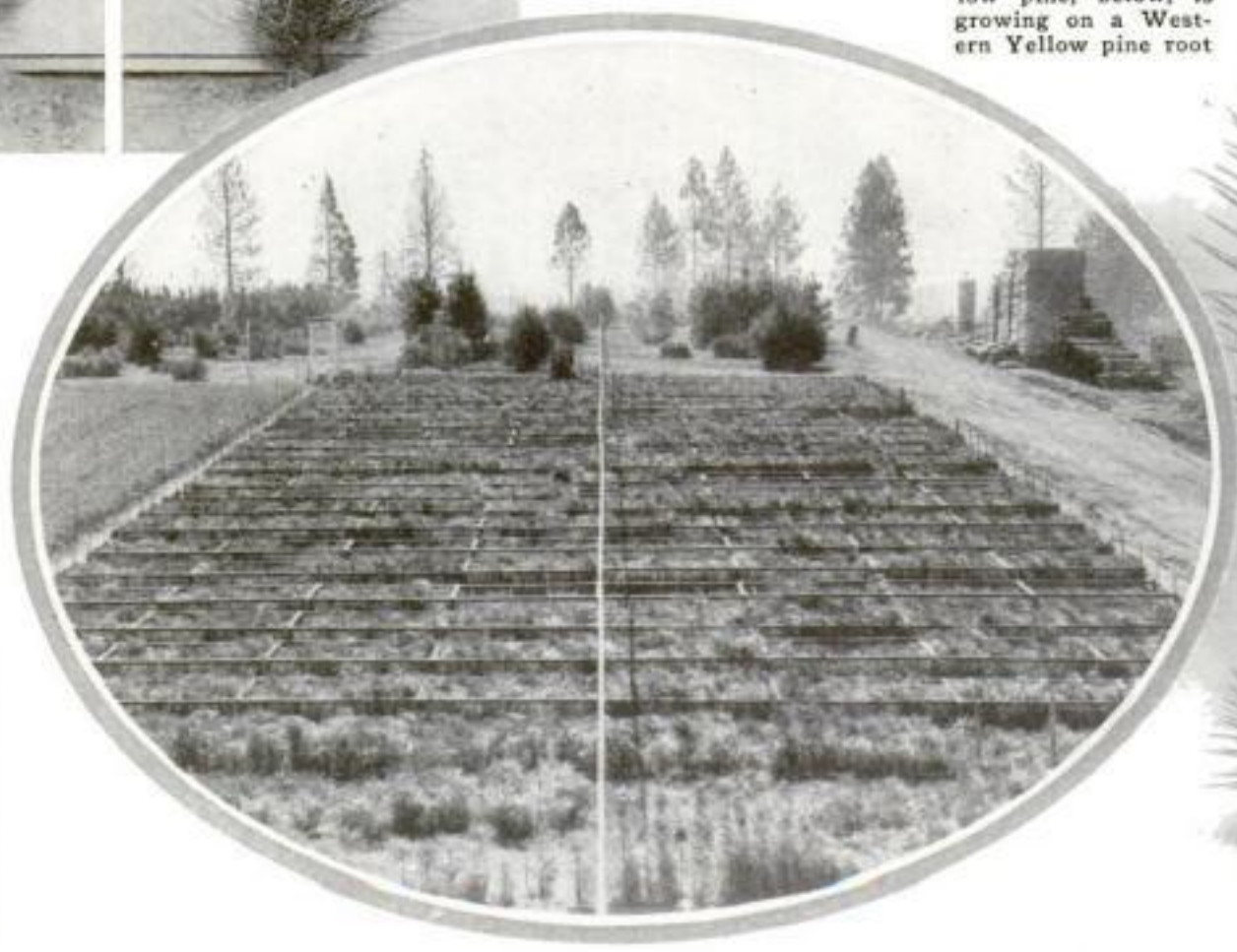
"Meanwhile, pollen from the desired, hardy male parent is obtained by gathering nearly ripe catkins, drying them, and shaking in a tight container. We subject each lot of pollen to a rigorous germination test. Incidentally, it has been discovered that pine pollen will retain its vitality as long as a year and can be shipped long distances. In fact, we have used pollen of pines native to India, China, Guatemala, Cuba, and other distant countries. The entire world is helping us produce super trees for our forests."

But this is only part of the story. The priceless golden yellow dust having been collected, it must be injected into the protective bag so that the open flower may partake of its vitality. Again, up the trees go the several assistants, sterilized hypodermic needles in their hands. A glance through the window reveals whether the flower has opened sufficiently. A quick thrust through the fabric, a squeeze of the rubber bulb, and enough of the yellow dust enters the bag to guarantee results. The operator covers the tiny hole made by the needle with a small piece of adhesive tape and moves on to the next flower to repeat the operation.

Danger stalks these men as they go about their business of applying birth



These two Western Yellow pine seedlings are of the same age and were grown under identical conditions. The one on the right was selected from fast growing, wood-producing stock. As you see, it is nearly twice as tall as the one at the left and is not wasting its vitality in worthless foliage



In this section of the tree laboratory, right, 3,060 separate plots contain seed from 765 Western Yellow pines. It is in such carefully guarded plots that studies are made of the various qualities of parent stock

This Mexican Yellow pine, below, is growing on a Western Yellow pine root

METHODS

Forests

Before pollen begins to fly, men go into the forest and tie bags around the flowers to prevent chance fertilization that would interfere with scientific work

control methods to embryonic trees, for much of the pollinization takes place a hundred feet above the ground. To scale such a tree the worker often wears spiked climbers; and safety belts do not wholly eliminate the thrills of working far above the earth in a swaying tree top. Excitement often attends the gathering of seed; in fact some cones are found to be so inaccessible they are brought down by well placed rifle shots.

Sturdy sons of the world's strongest, straightest-grained soft and hard woods thrive in this eighty-two-acre forest laboratory in the Sierra Nevada foothills. Nowhere does sound family stock count more than here, for in hundreds of instances you can see the offsprings of vigorous parents towering above their weaker relatives of the same age.

Ideal forest trees dot the nursery and arboretum. Many of them early give promise of the fine, towering timber they will be two decades hence, when, at what is youth for ordinary trees, they will have achieved full maturity in appearance and size. Already, when compared with normal seedlings, they have grown twice as fast as one ordinarily expects a forest tree to grow when left to itself.

Here one sees the application to trees of modern scientific knowledge of how, by selection and hybridization, superior strains of plants and animals have been developed. "The changes the Institute expects to bring about in pine trees, for example," Austin explained, "are just as attainable as the changes that have been brought about in the development of our highly improved varieties of fruit trees, grains, and vegetables from the original, wild plants. Timber trees are subject to the fundamental laws of heredity as is every other living thing."

Dendrograph attached to a tree trunk automatically records its growth. Here Dr. Ferdinand Haasis, of Carnegie Costal Laboratory, reads the tree record

To pollinate one of the bag-covered blossoms, the needle of a syringe filled with pollen is thrust into the bag and pollen released. The tiny hole is then sealed securely. At left, pollinated Western Yellow pine cones in which seeds mature

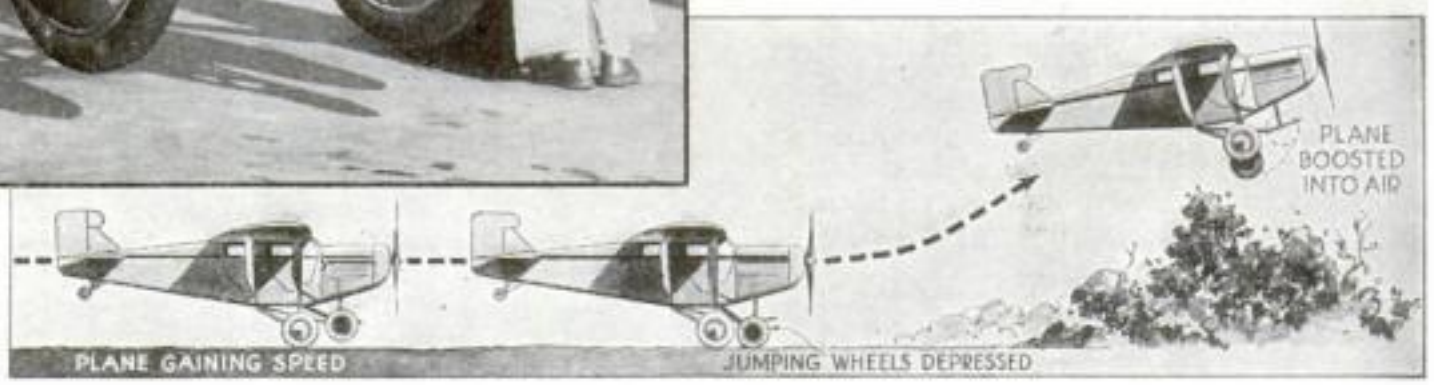
These men today concentrate on the pines, among the softwoods, and on timber walnuts, among the hardwoods, largely because the pines are most widely distributed and most generally useful, and the many species offer unusual opportunities to combine the best that nature, unaided, has produced. Walnut was chosen both because of its range and utility and of the work Luther Burbank and others already had done with it.

The Institute was founded in 1925 by James G. Eddy, Seattle, Wash., and was known as the Eddy Tree Breeding Station. During the past few years it has searched the entire Northern Hemisphere to bring together in its arboretum the most complete collection of pines in the world—including more than 100 species and varieties. Botanic gardens *(Continued on page 96)*

Grasshopper Plane Jumps into the Air

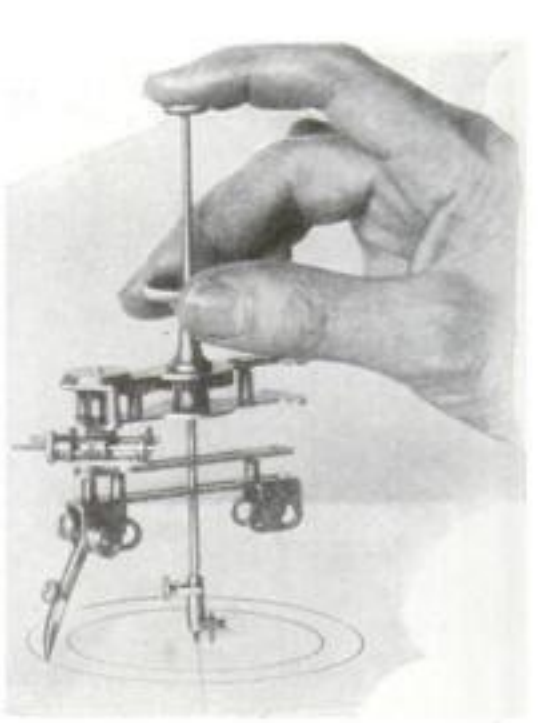
Two extra wheels on front of plane bounce it into the air when they are lowered to strike the ground. Diagram shows how depressed wheels hurl plane aloft so it can clear obstacles in its path

AN AIRPLANE that jumps into the air, like a grasshopper, is reported to have performed successfully in trial flights at an Alhambra, Calif., airport. Alonzo Mather, inventor of its boosting gear, sees possibilities for it in enabling airplanes to take off from the restricted space of a ship's deck or a small field bordered by trees or cliffs. The booster, a pair of auxiliary wheels on a swinging cradle, is normally suspended clear off the ground, in front of the landing gear. When the machine has almost reached flying speed at the end of a short runway, however, the pilot operates a control that swings the booster backward beneath the landing gear. The auxiliary wheels strike the ground with force, bouncing the craft into the air. Once the plane is aloft, the jumping gear is withdrawn. A small third wheel, installed to prevent the plane from nosing over, proved unnecessary and will be omitted in future models.



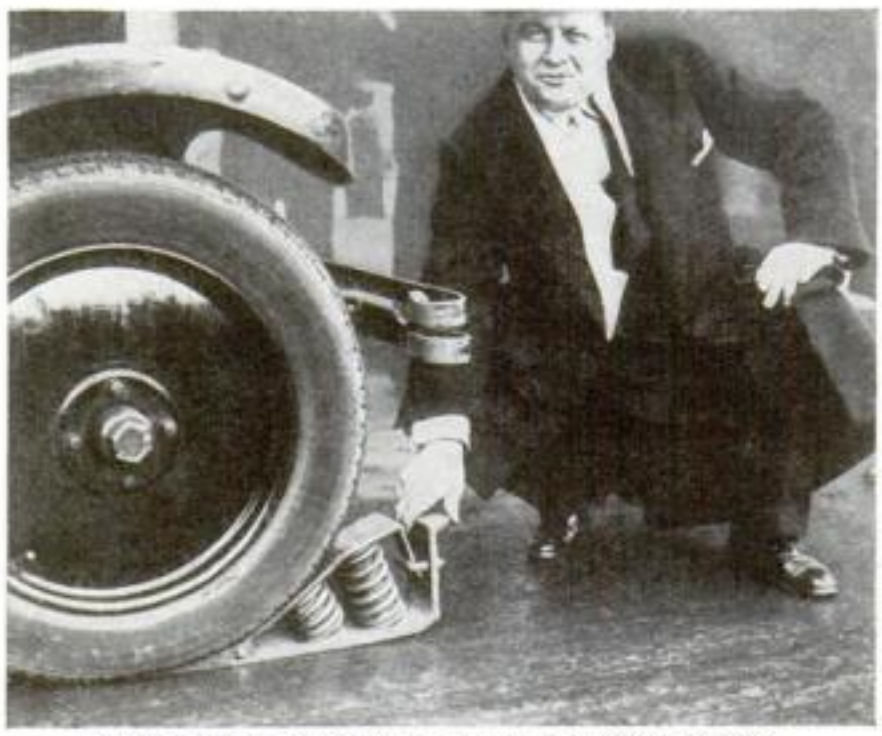
NEW SAFETY RAZOR HAS OSCILLATING BLADE

ESPECIALLY designed for those with tender skins and tough beards, a new safety razor employs an oscillating blade to cut the hairs. While the razor is drawn across the face, a pair of friction rollers revolve and cause the whole blade to move sideward with a reciprocating motion, as indicated by arrows in the photograph at left. As a result, this miniature mowing machine is declared to give an unusually close shave with a minimum of chafing and discomfort. The one piece razor may be operated and cleaned with one hand.



BRAKE STOPS FAST TRAIN IN 100 FEET

STOPPING a mile-a-minute express train within the space of 100 feet is one of the feats claimed within the power of a new type of emergency brake, invented by a Russian and demonstrated recently before police officials of London, England. According to the inventor, it may also be applied to automobiles and buses. When the driver presses a button, a device resembling a drag-shoe drops before wheels. Coil springs take up the shock and transform the forward motion into vertical lift.

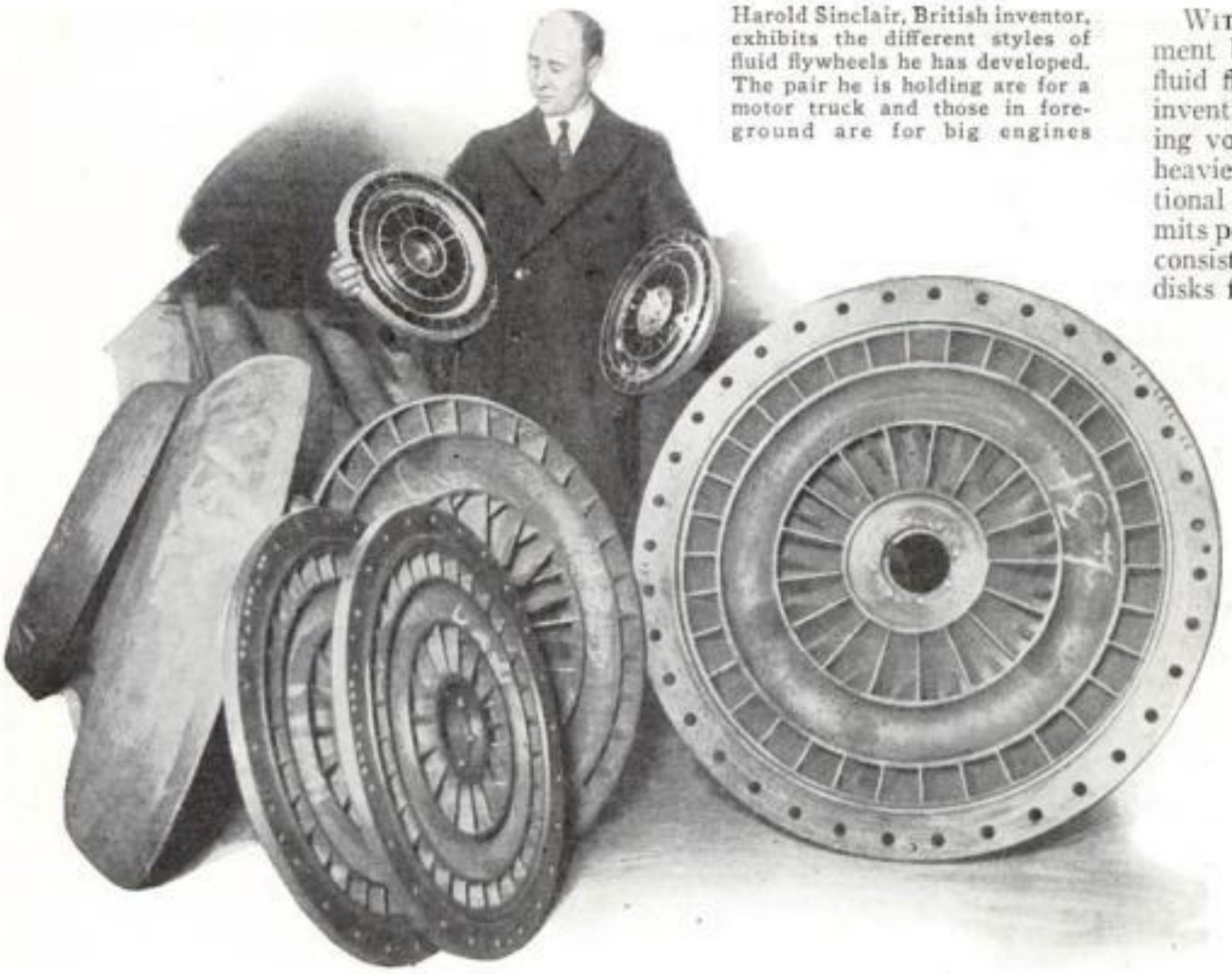


Demonstrating, on a fast bus, the use of emergency brake

TOOL FOR DRAFTSMEN DRAWS MANY CURVES

ELLIPSES, spirals, and other curves hitherto requiring complicated apparatus to draw correctly may now be inked-in with ease by an ingenious hand tool for draftsmen. The tool, which resembles a compass, is held in place with one finger resting on a center pin as shown in the illustration above. When a knurled ring is twirled with the thumb and finger, the pen traces out the desired curve. The type of curve drawn is determined by a preliminary setting made with a second knob above the pen. A system of gearing causes the pen to move toward or away from the center post as it describes an arc about it. Gears are changed for drawing different curves.

Fluid Flywheel Gives Auto Smooth Power



Harold Sinclair, British inventor, exhibits the different styles of fluid flywheels he has developed. The pair he is holding are for a motor truck and those in foreground are for big engines

WITH their adoption as standard equipment by four British motor car makers, fluid flywheels, a modern achievement of inventive genius, are coming into increasing vogue for automobiles as well as for heavier machinery. Replacing the conventional mechanism, the fluid flywheel transmits power with exceptional smoothness. It consists essentially of a pair of channeled disks free to revolve face to face without touching, within an oil-filled casing. Oil entrained between the disks, the only physical connection, causes the rotation of the one connected to the engine to turn the other. A car thus equipped glides forward so gently that a finger's touch will stop it.

Small enough to slip into an overcoat pocket, this chemical hand warmer will hold heat for a long time

CHEMICAL HAND WARMER FITS OVERCOAT POCKET

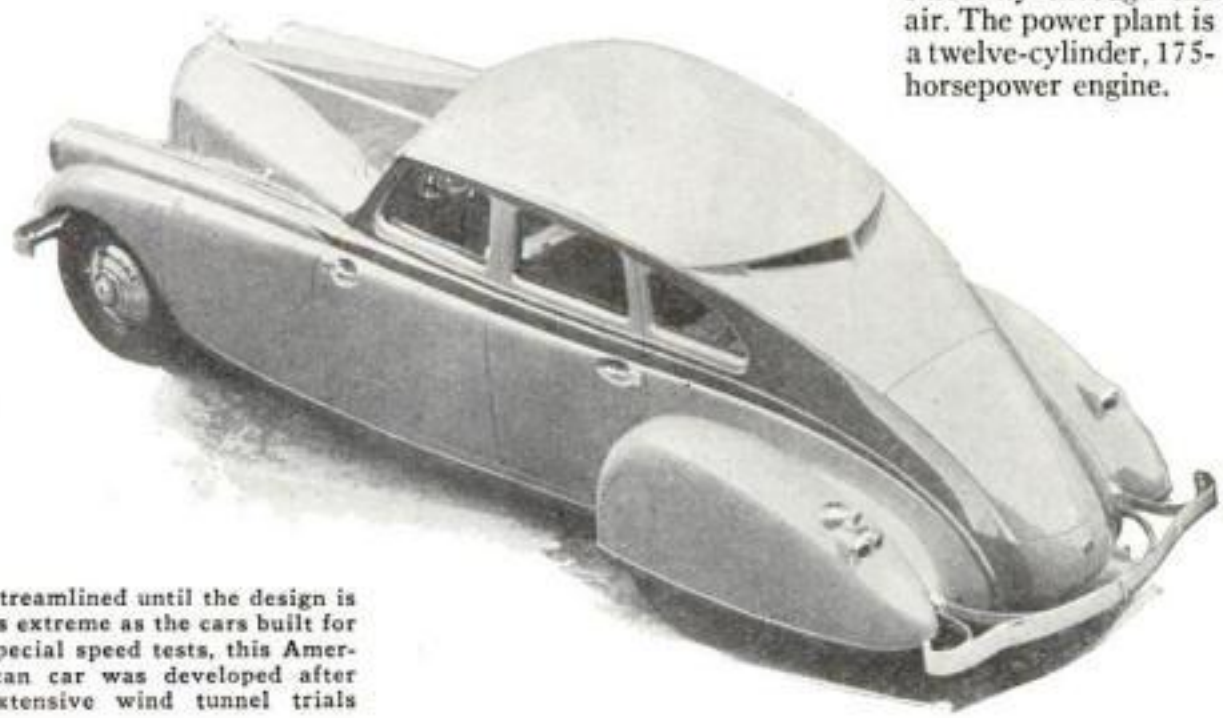
FIRST aid for cold hands is a new warmer that slips conveniently into an overcoat pocket. Fireless and devoid of electrical connections, it generates its own heat on the same principle as chemical heating pads of larger size. When a teaspoonful of water is poured into an inner bag containing a chemical mixture, and the bag is replaced in its cloth cover, the warmer emits a gentle heat for a considerable period. Since the chemicals may be used repeatedly, refills are needed only occasionally.

CLOUD-MAKING TOWER MAY SAVE ORCHARDS

FANTASTIC ideas of capturing electricity from the atmosphere have led to small practical results thus far, but a curious tower just erected atop a canyon ridge near Whittier, Calif., proves that such a dream is hard to down. The Los Angeles inventor and builder of the tower says he will use it in an attempt to release electrical charges from moisture-laden air. Thus he seeks to form a blanket of clouds at will, and achieve thereby a means of protecting orchards against frost.

ODD DESIGN IN NEW STREAMLINED CAR

A WELL-KNOWN American manufacturer of fine cars, usually of ultra-conservative style, has startled the motor world by producing a streamlined model that ranks with extreme conceptions of "the car of the future." Its contour, developed after extensive wind-tunnel tests, gives the new model a maximum speed of 115 miles an hour, while at cruising speeds of sixty to eighty miles an hour it slips silently and smoothly through the air. The power plant is a twelve-cylinder, 175-horsepower engine.



Streamlined until the design is as extreme as the cars built for special speed tests, this American car was developed after extensive wind tunnel trials

Electric Taster Measures Fruit's Acid

The electric dial shown in the circle reveals the sweetness or sourness of fruit. If the prongs of the instrument are inserted in the mouth, its acidity is shown

WHILE R. C. Hitchcock, Westinghouse engineer, was enjoying a luncheon in his laboratory not long ago, it occurred to him that the apple that constituted his dessert contained a certain amount of electrical energy. He inserted a pair of wires from a sensitive electric meter—and it began to register. From this experiment was born a new instrument known as the "electrynx," or electrical taster. When its electrodes are plunged into oranges, lemons, apples, or grapefruit, it shows at once the sweetness or acidity of the fruit and its ripeness. In another test, it proved able to reveal an acid condition of the mouth.

WALKER CAN TUNE IN WITH RADIO IN CANE

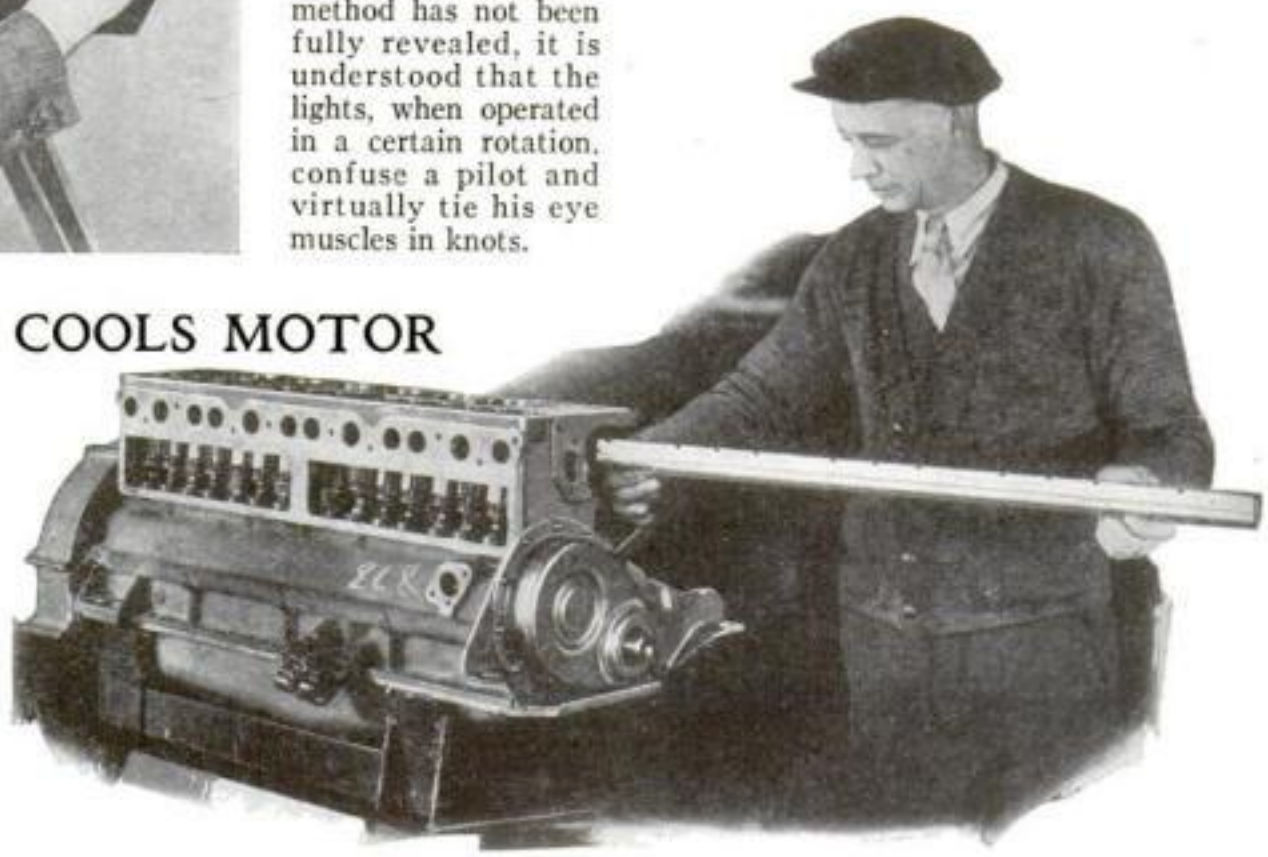
SO THAT a pedestrian may enjoy broadcast programs wherever he goes, a German inventor, Alfred Mintus, has devised what he calls a "radio walking stick." Outwardly it resembles an ordinary cane, but the interior contains a miniature receiver and batteries. The user has merely to plant the stick in the ground, adjust a pair of pocket 'phones to his ears, and listen in, as illustrated in the photograph. It only remains now for the inventor to perfect the apparatus so the pedestrian need not interrupt his walk while listening in, a possibility foreseen by the inventor of the cane.

LIGHT RAYS TO FIGHT AIR RAIDERS

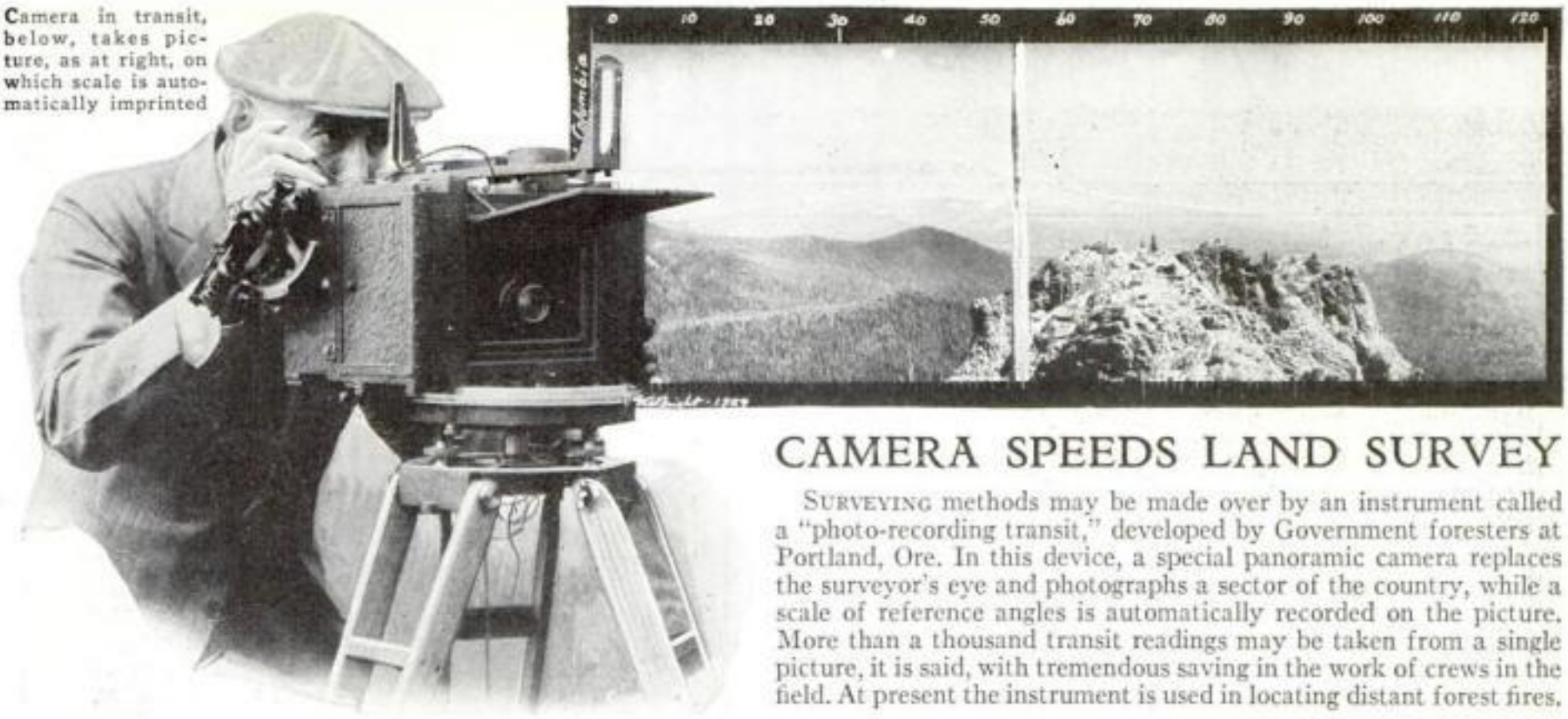
A SECRET system of searchlights to put air raiders out of commission has just been demonstrated before British Air Ministry officials by L. G. Toplis, English electrical engineer. His special lamps are said to be designed to bewilder enemy pilots, causing them to lose control and crash. Though the method has not been fully revealed, it is understood that the lights, when operated in a certain rotation, confuse a pilot and virtually tie his eye muscles in knots.

WATER IN PIPE LINE COOLS MOTOR

A NEW departure in auto cooling systems, just introduced in a car of familiar make, brings water directly from the radiator to vital parts of the engine through a pipe line. The water circulates first in special cooling jackets around the exhaust valves, hottest spots on the whole motor; then it passes on to cool the intake valves, and the cylinder head and barrels, before being returned to the radiator. A water pump bolted over the pipe line opening provides a circulation of 1,200 gallons an hour at twenty-five-mile speed. This results in an efficiently low temperature, it is said.

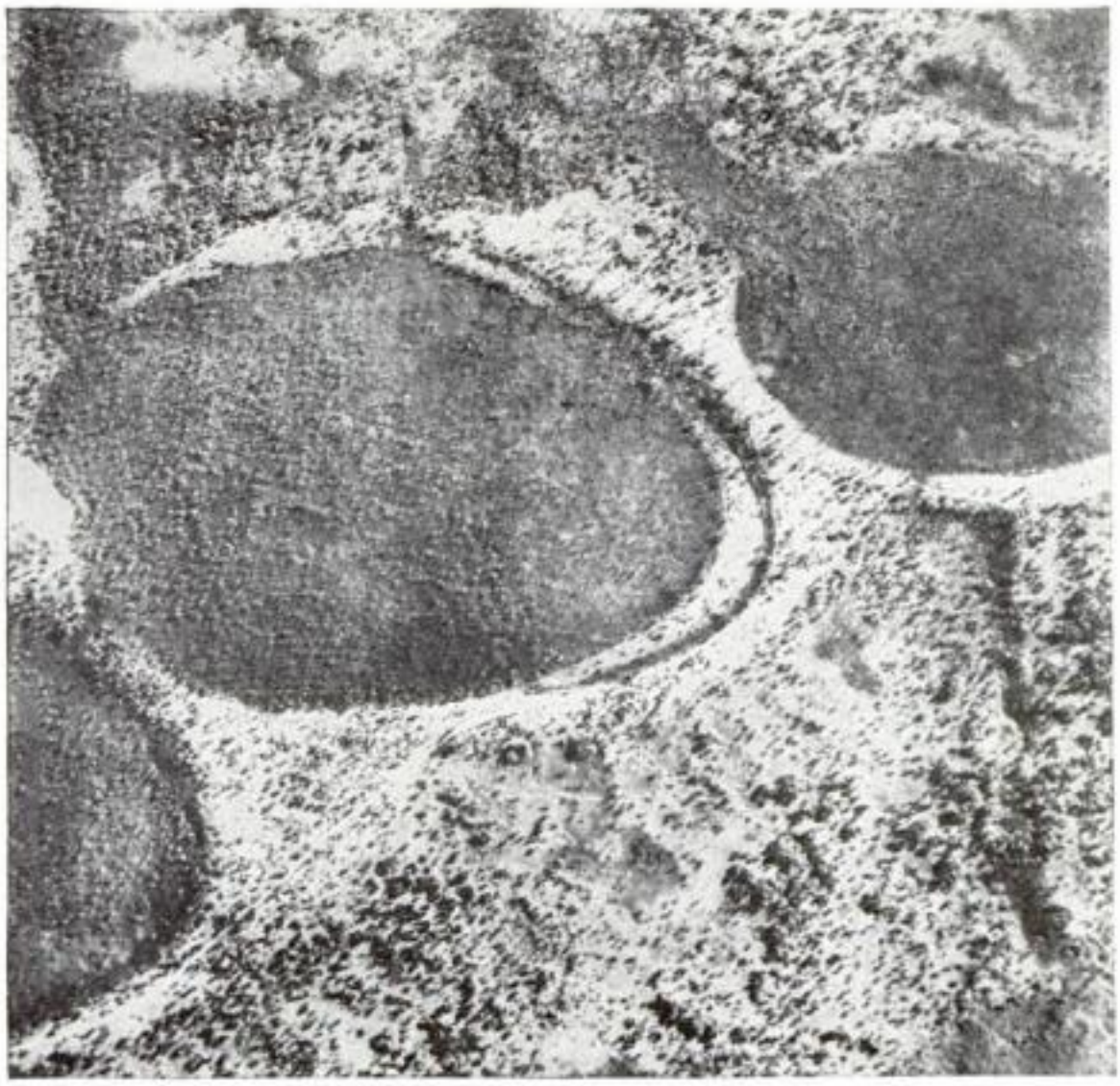


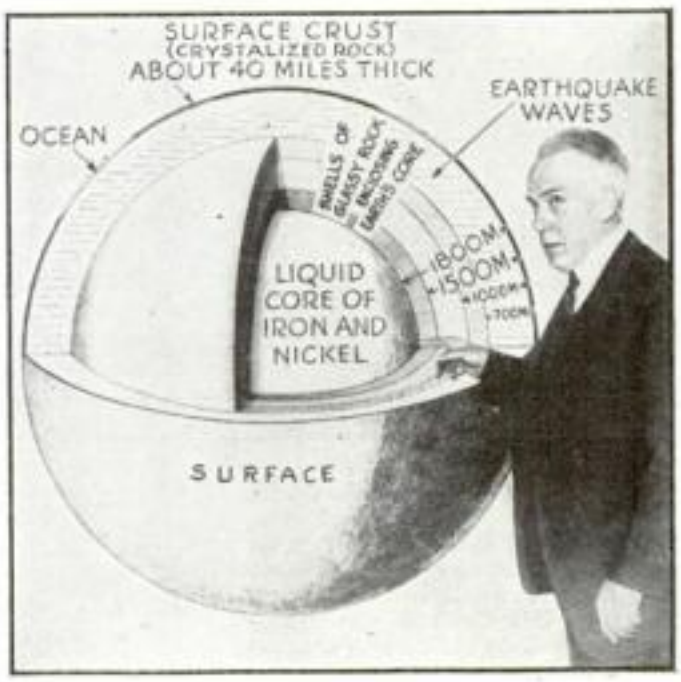
Camera in transit, below, takes picture, as at right, on which scale is automatically imprinted



CAMERA SPEEDS LAND SURVEY

SURVEYING methods may be made over by an instrument called a "photo-recording transit," developed by Government foresters at Portland, Ore. In this device, a special panoramic camera replaces the surveyor's eye and photographs a sector of the country, while a scale of reference angles is automatically recorded on the picture. More than a thousand transit readings may be taken from a single picture, it is said, with tremendous saving in the work of crews in the field. At present the instrument is used in locating distant forest fires.



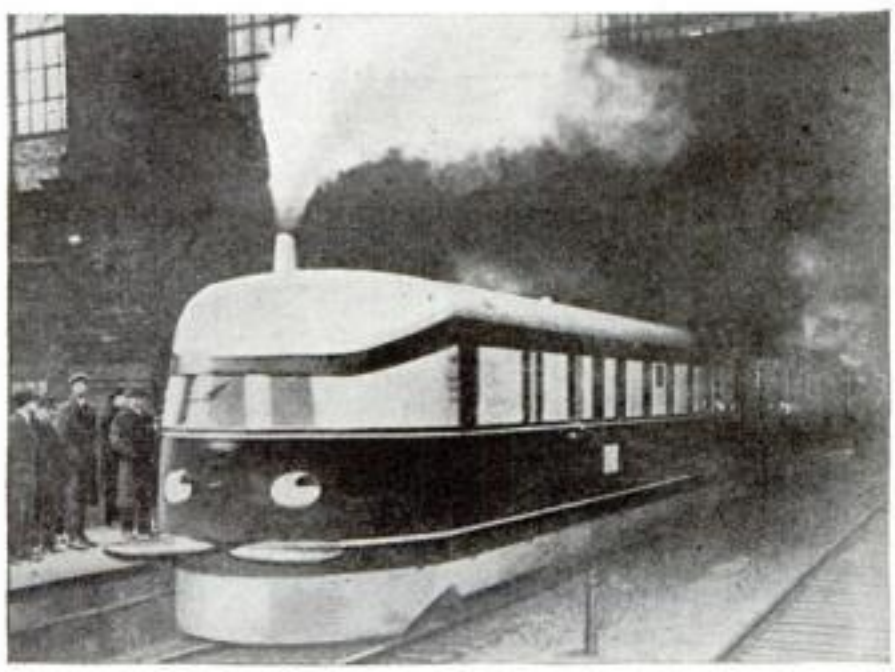


MODEL SHOWS LATEST IDEA OF EARTH'S CORE

WITH the aid of the sectional diagram illustrated above, Professor R. A. Daly, Harvard University geologist, recently gave the Geological Society of America the latest scientific conception of the interior of the earth. The forty-mile-thick crust on which we stand constitutes its real strength, he says. The interior he pictures as a fragile, glassy shell with a tremendously hot, liquid core.

AIR PHOTOS SUGGEST BIG COMET HIT EARTH

DID a giant comet once collide head-on with the earth? Prof. F. A. Melton, University of Oklahoma geologist, recently completed a field study of mysterious elliptical pits averaging half a mile long, found in numbers in North and South Carolina by aerial photos like the one reproduced above. His observations suggest they were the result of a collision with a comet composed of a cluster of meteorites traveling six miles a second. The prehistoric bombardment, he says, probably lasting about a minute, must have provided so awesome a spectacle as to make the World War seem like play.



TEST TRAIN AT 100-MILE CLIP

SNAPPED just as it was leaving the Berlin station in the striking view at left, Germany's new streamlined train, the "Flying Hamburger," hit a speed of nearly 100 miles an hour on its first passenger run to Hamburg. To minimize wind resistance, even the door knobs are sunk within the body. Big Diesel motors, located at front and rear, drive the two-car train, which seats 102 passengers.

Midget Sub to Seek

Simon Lake's Underwater Craft Makes Trip to Bottom of Long Island Sound

Midget submarine ready for its first test. Dr. William Beebe, famous naturalist, left, with Simon Lake, craft's inventor, and Frank Crilly, veteran diver who left the sub while submerged. At right, with hatches closed, the sub is going down

WHEN Simon Lake, famous submarine inventor, once asked a farmer what crop gave him the greatest profit per acre, the farmer replied, "Beans. I make sixty dollars for every acre I plant."

"Would you believe," Lake asked him, "that I know where you can get a return of $3,000 to $4,000 an acre? By farming the floor of the ocean, where riches in clams, sponges, and pearl oysters are free for the taking—to say nothing of sunken treasure!"

"But how are you going to go down and get them?"

"In a baby submarine!"

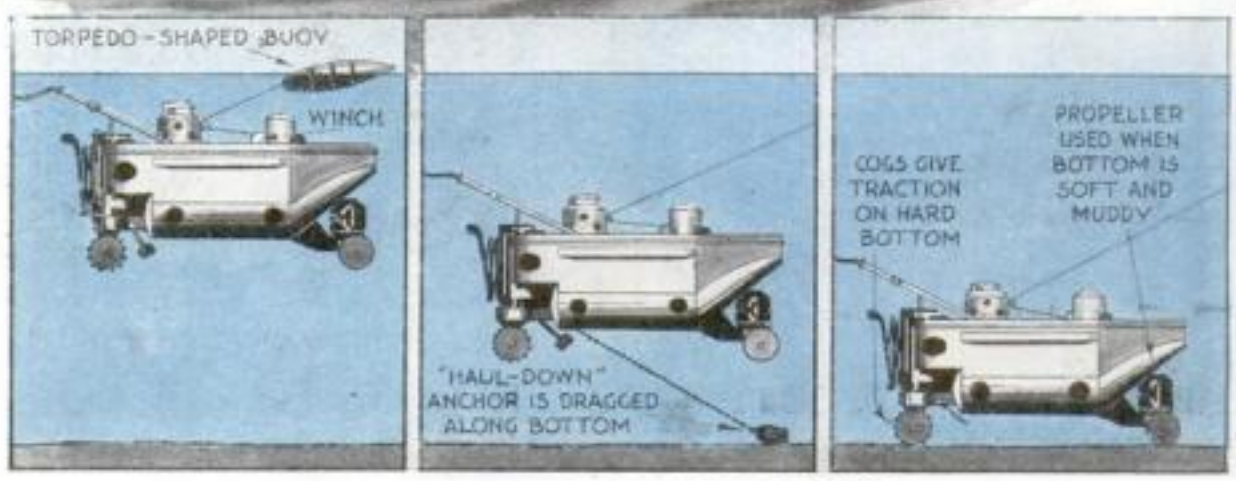
Engineers and officials who witnessed the first public demonstration of his twenty-two-foot submarine *Explorer* off City Island, N. Y., the other day, and heard Simon Lake retell this story, saw his dream on the point of realization. Purely for such peacetime pursuits as submarine farming, undersea exploration, and mapping, and the location of wrecks, he has designed and built what is probably the strangest undersea craft ever conceived.

First of a fleet to be built and leased to fisheries and salvage firms if it proves practical, the *Explorer* is a captive submarine. Floating on the surface, it resembles a pair of milk cans on a raft. Air and electricity reach it through hose and cables from its mother ship, the auxiliary ketch *Normona*. At the end of its 500-foot tether, the *Explorer*, which can descend safely to 300 feet, cruises under the power of an electrically-driven propeller, or it may be towed while submerged.

Two men, one standing beneath each of the conning towers, constitute the crew; two additional passengers can squeeze into a forward compartment provided with seats. The occupants are in constant telephone communication with the men aboard the *Normona*, to whom they can report what they see through twenty portholes and windows in the conning towers and hull.

When the hatches are slammed shut, fresh air comes hissing in through a hose from the *Normona's* compressed air tanks. A second hose draws out used air. Thus the submarine's occupants, after they have manipulated valves that fill the submarine's ballast tanks with water and send it toward the bottom, continue to breathe as comfortably as if they were out-of-doors. The reading of a depth gage and a gentle bump are the only indications that the craft has reached the bottom.

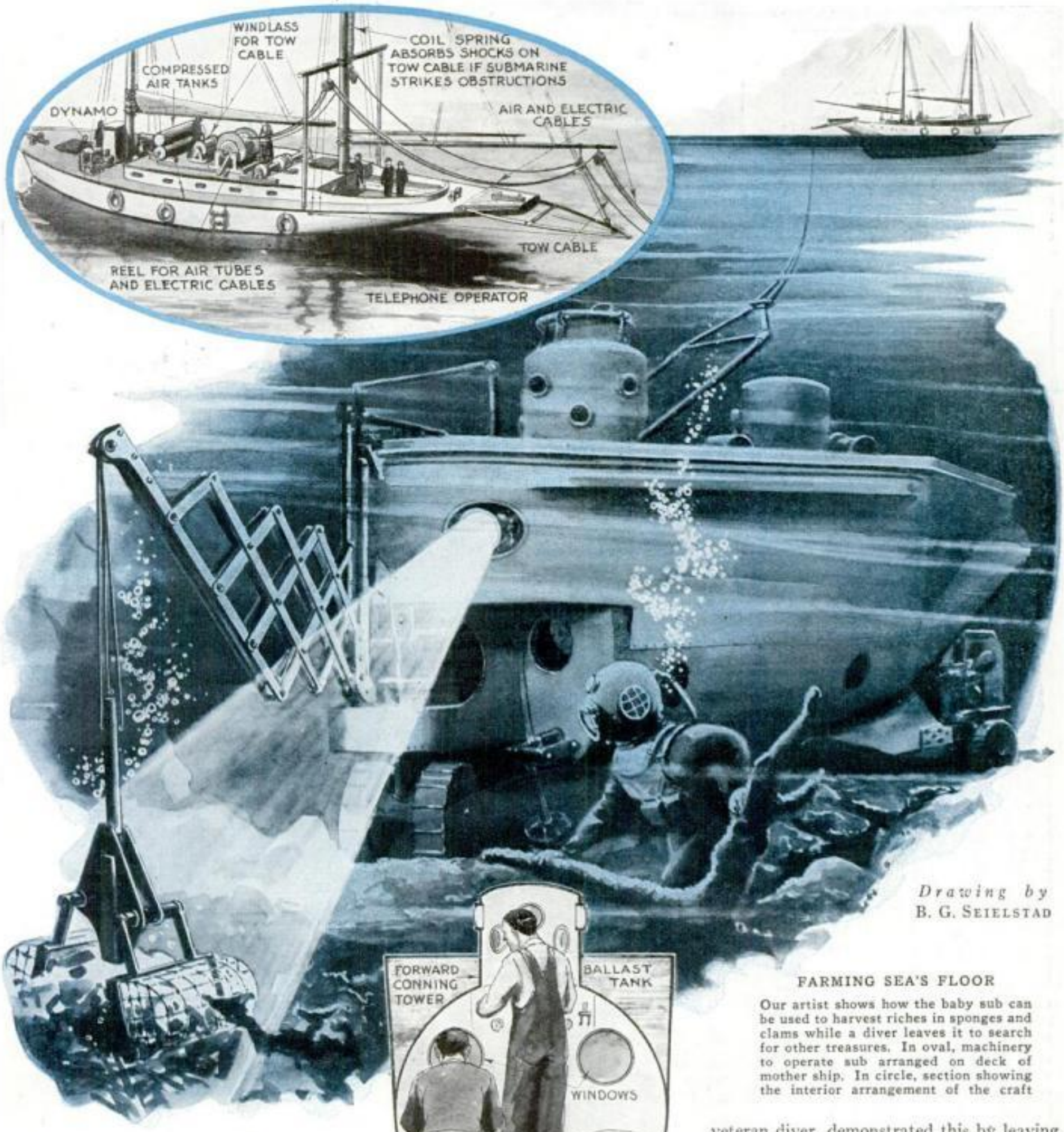
Spectators at the City Island demonstration saw a craft fitted with accessories of a highly unconventional sort. The *Explorer* rolls along the sea bottom like a submarine runabout, on thirty-inch iron wheels, driven by the same motor that operates the propeller. The wheels may be turned in any direction; the craft advances or moves sideward like a crab with equal ease. Two 5,000-watt floodlights illuminate the submarine landscape.



FLOATS AND ANCHORS HOLD THE SUB

Drawings show how the new submarine maneuvers near the surface, near the sea's floor, and when actually on the bottom. Note floats and anchors that hold it in desired position

Riches on Sea's Floor



Drawing by
B. G. SEIELSTAD

FARMING SEA'S FLOOR

Our artist shows how the baby sub can be used to harvest riches in sponges and clams while a diver leaves it to search for other treasures. In oval, machinery to operate sub arranged on deck of mother ship. In circle, section showing the interior arrangement of the craft

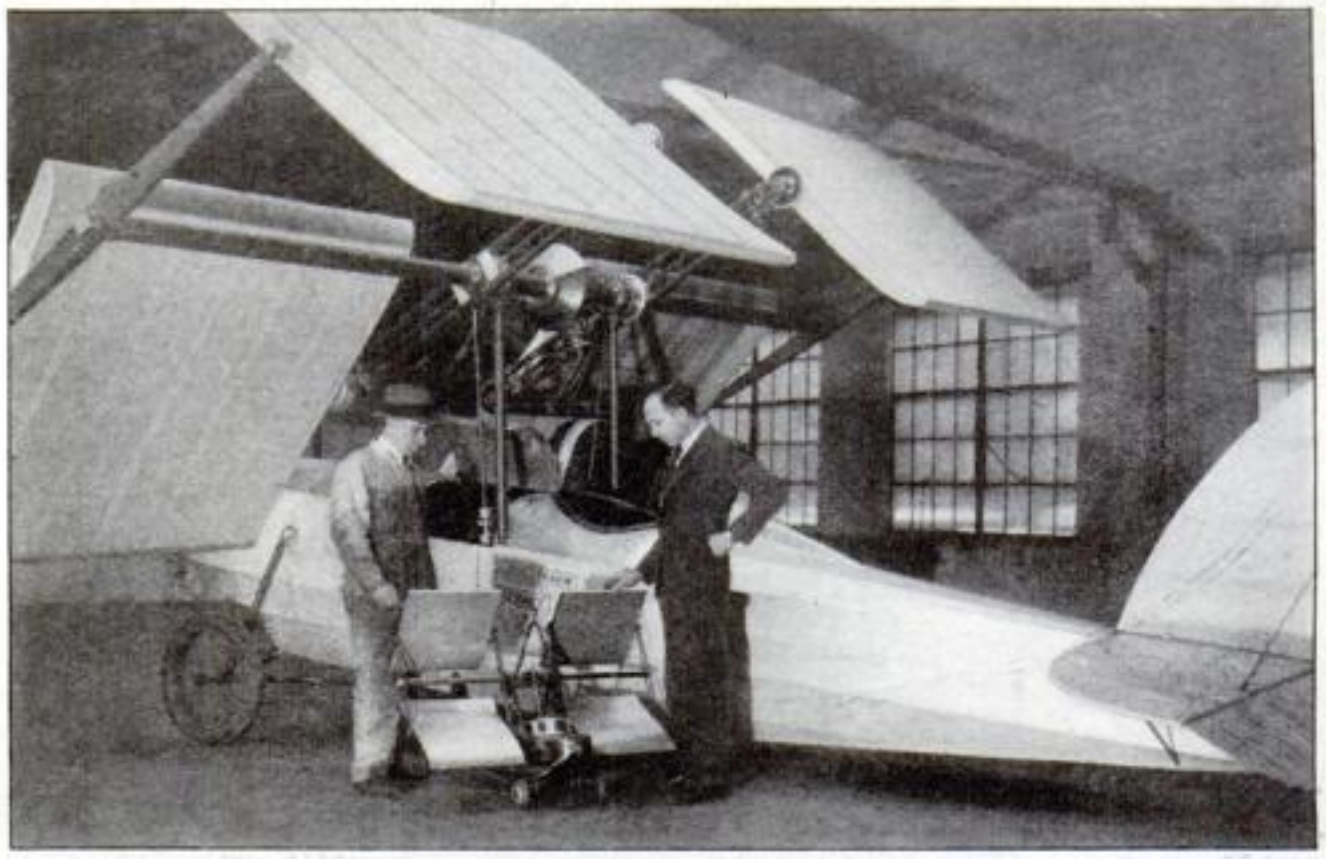
To reach out and touch the submarine wonders, the crew need only raise the air pressure within the submarine. A valve is turned, the men swallow three or four times to relieve the mounting pressure on their ear-drums—and, with the submarine transformed into a giant air-lock, a sliding door on the bottom of the hull may be opened to the sea. Water will not come in. To test this novel way of collecting specimens, Dr. William Beebe, noted naturalist, recently sat beside the submarine's open hatch and through the trap door, scooped a starfish from the bottom of Long Island Sound.

A diver may step through the trap door and go exploring for treasure, or inspect piers and bridge foundations. Frank Crilly, veteran diver, demonstrated this by leaving the *Explorer* under water, and coming to the surface, still receiving air by hose from the submarine.

One of the submarine's oddest accessories, a lazy-tongs crane at the bow, harvests sponges and deposits them in a basket lowered from a surface ship. Downward-pointing propellers just aft of the front wheels, harvest long-necked clams by washing away the bottom mud in which they burrow. This method avoids breaking their fragile shells, as would occur in dredging. Special floats and anchors regulate cruising depth, while stern rudders enable it to dive suddenly in pursuit of a school of fish or a harpooned whale— an aid in underwater photography, which will be the *Explorer's* first task.

Whirling Vanes Lift and Drive New Plane

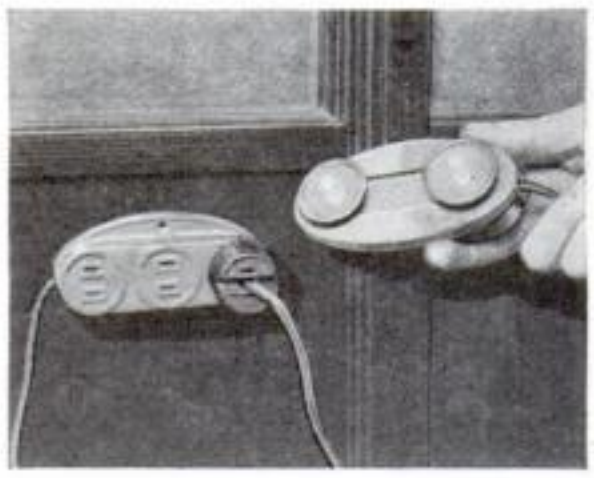
FOUR square vanes on revolving frames serve as wings and propeller for an airplane soon to have its first flying trials. The vanes rotate on pivots, presenting a nearly flat surface as they descend. This feathering action, the new York inventor, William Rahn, believes will enable the craft to hover in the air or to speed forward at a rate of 135 miles an hour. Power is transmitted to the vanes from a 240-horsepower air-cooled motor. The fuselage and tail surfaces resemble those of a conventional airplane.



Revolving vanes are designed to serve both as wings and propeller on the strange plane shown here. In the foreground is a small model to demonstrate the use of the principle on a big plane

PLUNGER IN HUMIDOR FILLS YOUR PIPE

SMOKERS now are offered a humidor that not only keeps tobacco moist and fresh, but even fills their pipes for them. Raising and lowering a plunger on top of the bowl stirs the contents, deposits a measured charge in a pipe placed beneath an opening, and tamps it down, as shown in the photo at left. Recesses for pipes, cigarettes, and matches are provided in the base of the humidor.



MASKS TESTED WITH REAL POISON GAS

TEMPTING death daily is the lot of a few daring men in a London laboratory, where a steel-walled chamber containing an appreciable quantity of real poison gas is reported in use to test the air-purifying canisters of military gas masks. Masked experimenters sit outside the deadly chamber, and breathe through hoses that terminate in the canisters within. A white-coated physician stands near to render first aid, in case the poison-absorbing chemicals should fail to function. Only in this way can new types of equipment be tested.

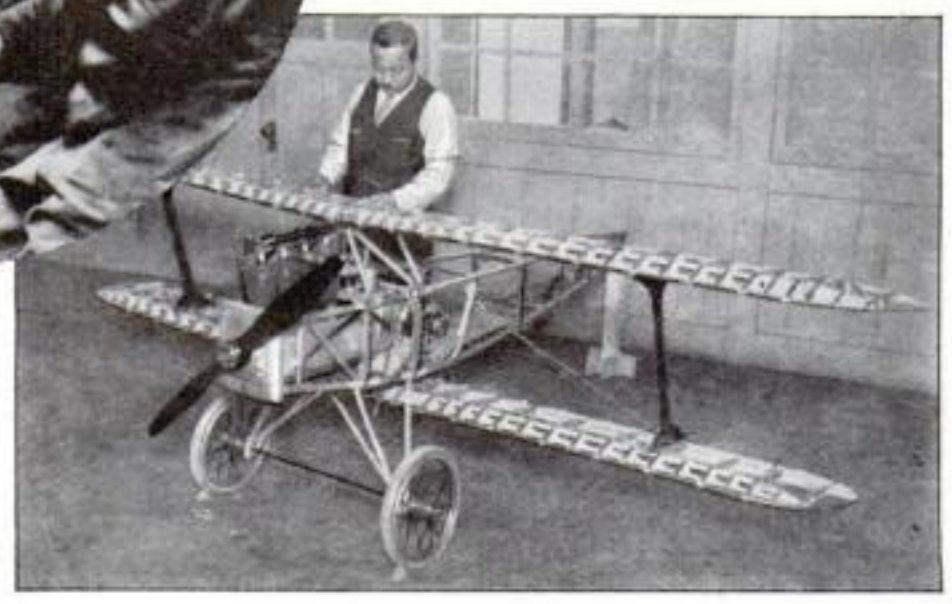
Photograph in circle shows English experimenters wearing gas masks and breathing poison gas coming from canisters set in a sealed room

TWO VACUUM CUPS HOLD NEW OUTLET TO WALL

VACUUM cups fitted to a new convenience outlet enable it to be attached instantly to a wall, wherever it is needed, and moved from place to place if the occasion should arise. The handy accessory provides connections for three appliances. It is supplied with nine feet of cord and a special plug with an additional outlet. The photograph above shows one of the outlets attached to a wall, while another is held bottom side up to show the two suction cups.

RADIO CONTROLS PLANE MODEL

TO DEMONSTRATE the airworthy qualities of a safety plane he has designed, a Japanese inventor is building the remarkable model, illustrated at the right, to fly under its own power. It will be powered with a four-cylinder gasoline motor, and the inventor, R. Okahara, proposes to steer and land it by radio control. A stabilizer, similar to one planned for the full-sized craft, will adjust the wings automatically to compensate for sudden gusts of wind.

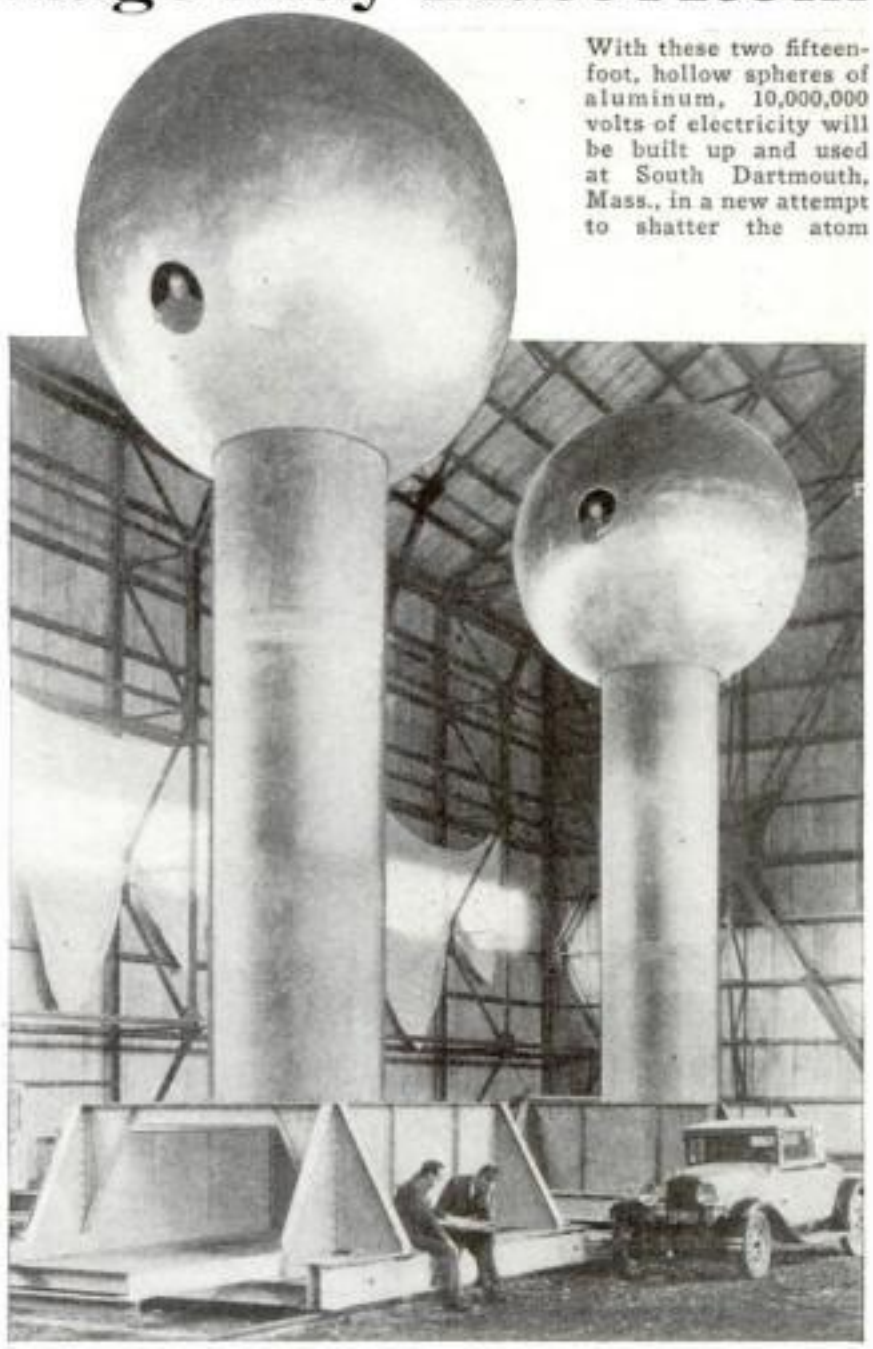


GLOBE STORES LIGHT FROM ELECTRIC BULB

STORING light in a globe was a feat recently demonstrated by Ethan I. Dodds, America's most prolific inventor, whose collection of more than 2,000 patents was exceeded only by those of the late Thomas A. Edison. The evacuated interior of Dodds' magic globe, which is covered by twelve of his U. S. patents, is coated with a mixture of phosphorescent chemicals. When an electric bulb is held in an aperture and flashed on momentarily, the lamp glows with a soft, even light for two hours. The bottled light, Dodds says, is suitable for use in mines and in industrial buildings, where a night watchman making his rounds, could recharge each globe with a flick of his flashlight.

Giant Voltage May Blast Atom

MAN-MADE lightning will soon flash in a blimp hangar at South Dartmouth, Mass., where a fantastic machine to harness the power of 10,000,000 volts is nearing completion. Sitting inside one of its two hollow spheres of aluminum, nearly fifteen feet in diameter, an operator will apply the huge voltage to a vacuum tube. Though his body will be charged to the same voltage as the spheres, he will be as safe as though he stood a mile away. Scientists at Massachusetts Institute of Technology will use the big generator in an attempt to blast atoms to pieces. The striking photograph reproduced here gives an impression of the machine's proportions. Whirling endless belts of silk pile up charges of electricity on the spheres by a new principle, which the inventor demonstrated a year ago.



With these two fifteen-foot, hollow spheres of aluminum, 10,000,000 volts of electricity will be built up and used at South Dartmouth, Mass., in a new attempt to shatter the atom

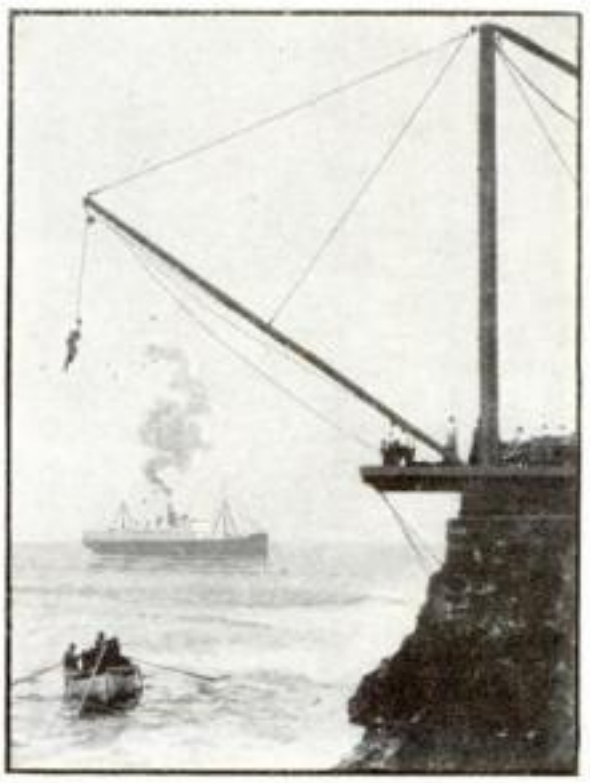
NEW POLICE SIGNAL BOX FOR HOMES

TO CURB the activities of burglars in Berlin, Germany, civilians are availing themselves of a new service offered by the city's police department. An emergency police box is installed in a home or apartment. Should the householder hear a suspicious noise or see a robbery from his window, he has only to pull the handle of the box. A call light flashes up in police headquarters and directions, tapped out on an automatic typewriter, send a squad of police racing to the spot.

An emergency call to the police is turned in when the lever on the box shown in the circle is pulled down. The signal box, installed in a private home, is part of a new system adopted in Berlin. At left, the emergency call received at police headquarters where an automatic typewriter gives the location of call

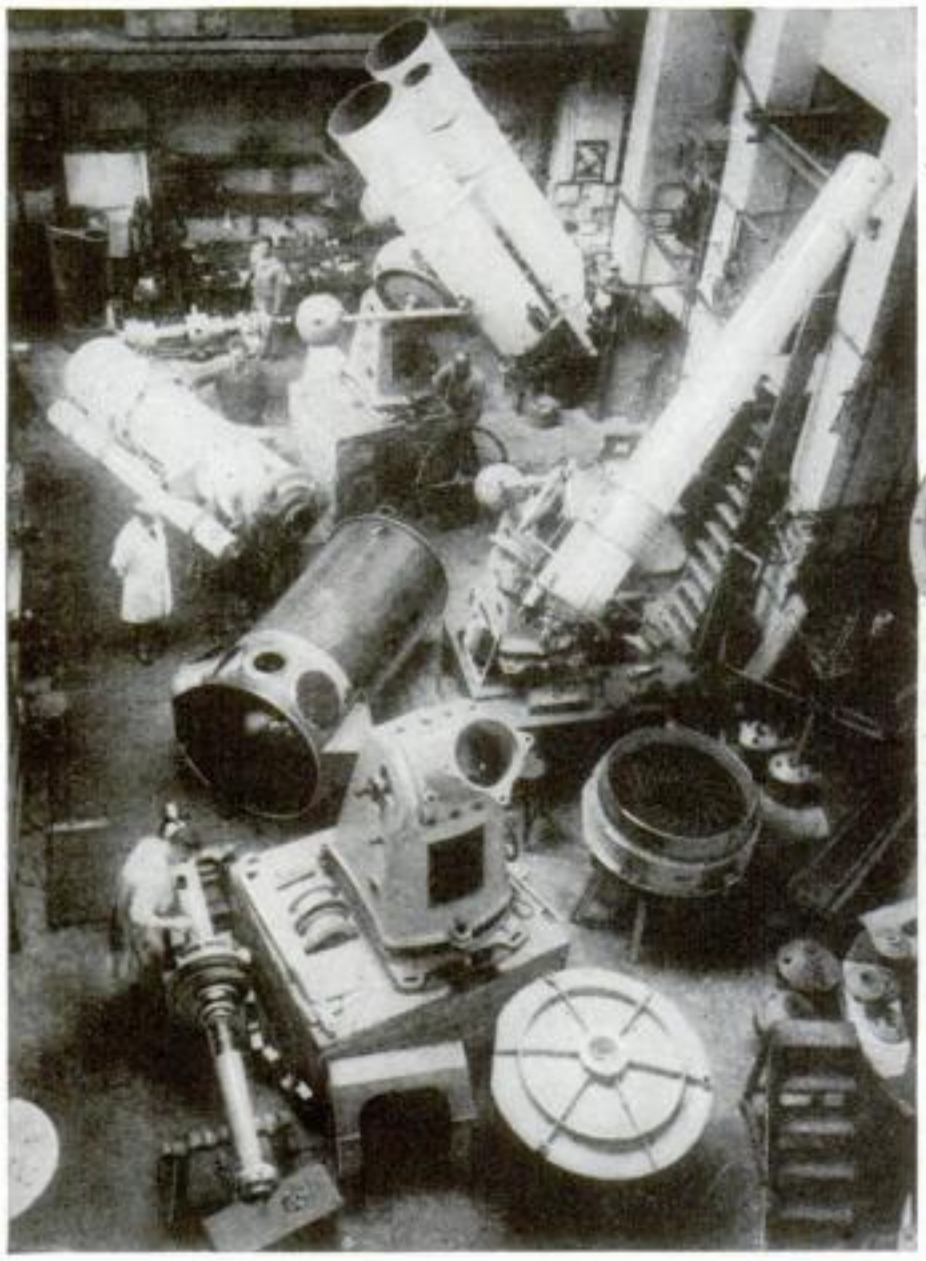
SHIP'S PASSENGERS ARE LANDED WITH DERRICK

SCENES like that in the photograph below, suggesting a thrilling sea rescue, take place when visitors land on the jagged coast of Hamakua, Hawaii. There small boats bring passengers within range of a derrick-like landing gear that has been erected on a cliff. One by one, the passengers are hoisted ashore.

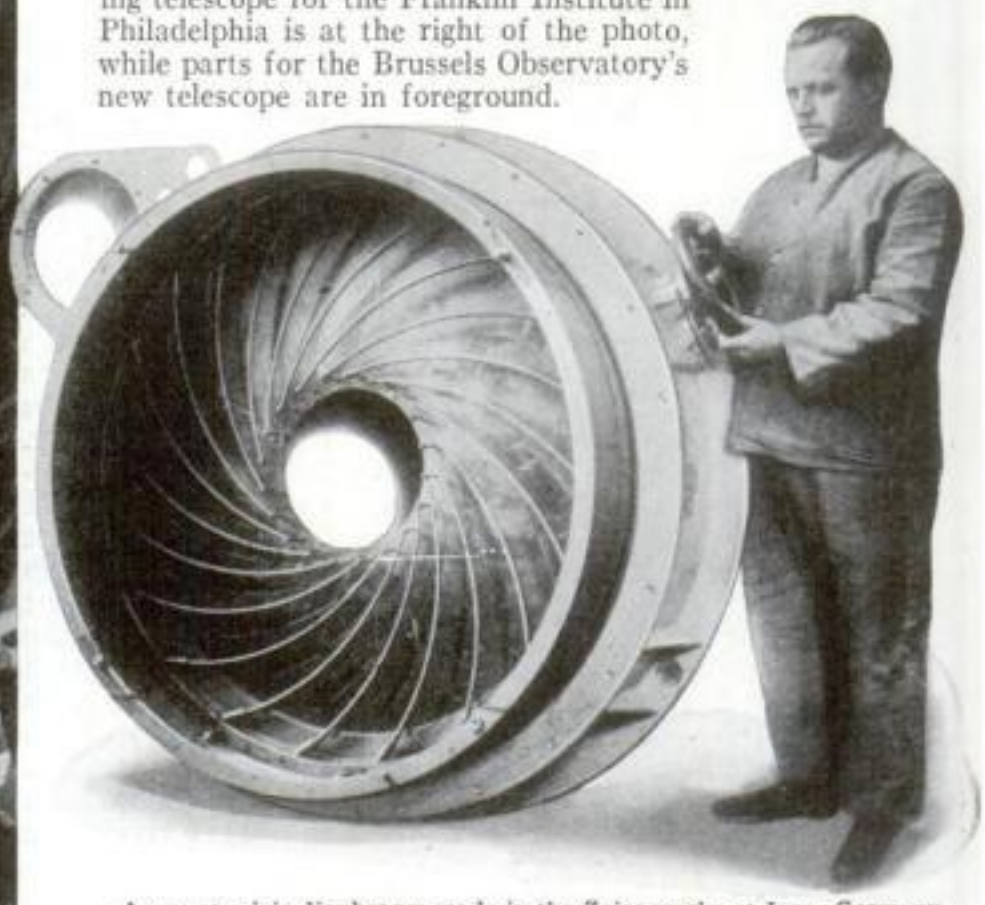


Derrick-like landing gear used at Hamakua, Hawaii, to swing ship's passengers ashore

Where Telescopes Look Like Big Cannon



STRIKING scenes, resembling those in a gun factory, confront a visitor to the famous Zeiss works at Jena, Germany, where telescopes for many of the world's largest observatories are built. A number of these Big Berthas of the sky, ready for shipment, presented an unusual sight recently when a photographer snapped the view at the left. In the background is a photographic telescope, with a sixteen-inch lens, for the Brussels Observatory in Belgium. The long barrel of a big refracting telescope for the Franklin Institute in Philadelphia is at the right of the photo, while parts for the Brussels Observatory's new telescope are in foreground.



A monster iris diaphragm made in the Zeiss works at Jena, Germany, for the Brussels Observatory. At left, telescopes partly built

COVERING FOR ELECTRIC CORD ENDS KINKING

TROUBLESOME kinks in cords for the telephone, the electric iron, and other household fixtures are prevented by a new elastic covering. Simple to attach, it is merely wound around the cord as shown in the photograph, without need of disconnecting any of the wires. The cord's flexibility is not impaired, but there is no longer any tendency to snarl. Since the covering contains no metal, it cannot cause a short circuit. It is also adapted for use on electric light long extension wires.

This elastic covering is wrapped around telephone cords to keep them free of kinks

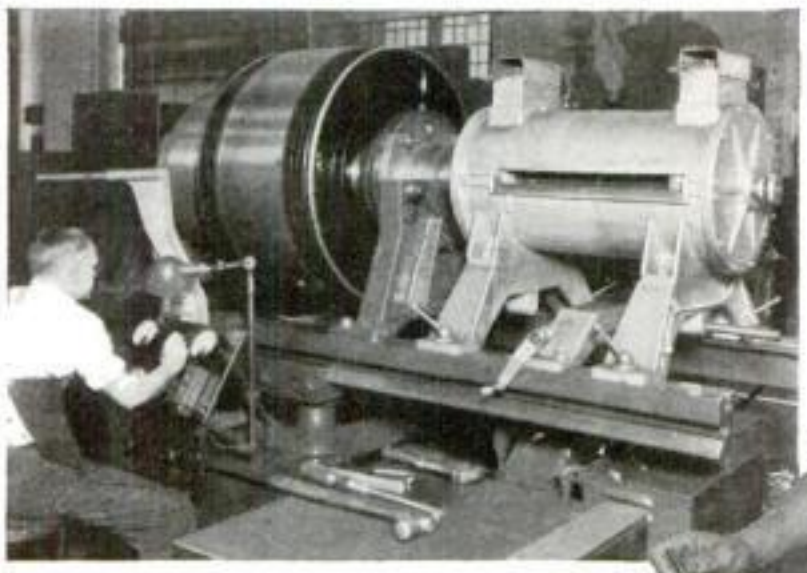
PAINTER'S SLIDE RULE HELPS MATCH COLORS

A COLOR slide rule, to aid in matching any tint, has been devised by a large paint manufacturer. One of the cardboard devices is supplied for each color. When the painter has to match a brown auto enamel, for example, he selects the brown card and pulls down the slide, attempting to match the color on the auto as seen through an aperture in the card. Since two areas are compared side by side, a match is easy.

DETACHABLE CAR TRUNK FITS OVER SPARE TIRE

FITTING over the spare tire, a new detachable trunk for automobiles is held in place by a single wing nut and bolt. Only a few seconds are required to attach or remove it. The tire serves as a shock absorber for the contents. Especially useful for picnics, the trunk may be packed with food and removed later to the scene of the meal without unpacking it.

Toys Used by Scientist in Study of Vibration



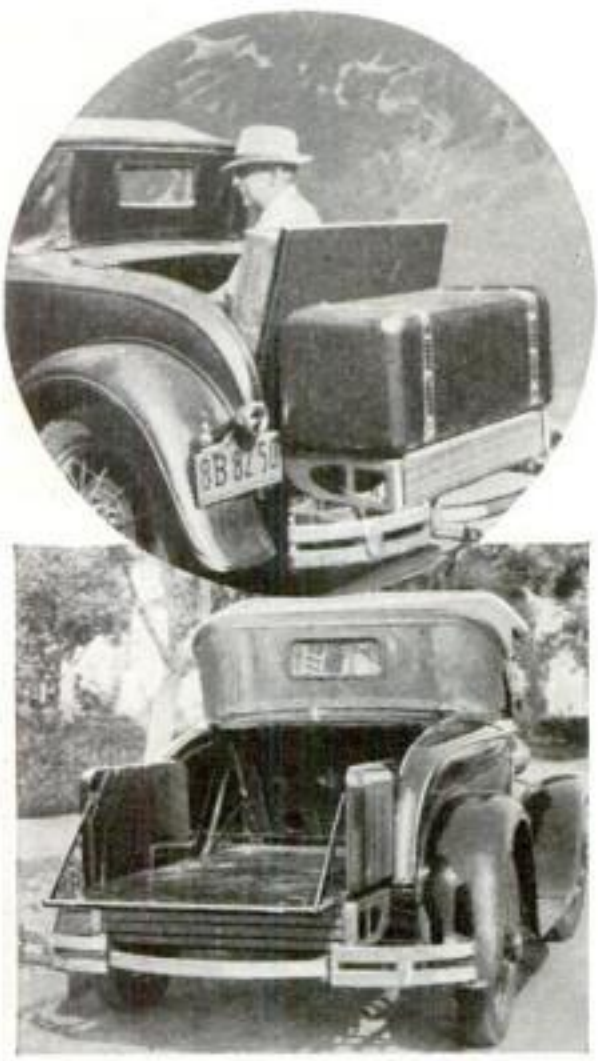
Recent studies of self-induced vibration will enable engineers to make big dynamo armatures, like the one above run more smoothly

Only a toy to children, yet the negro shuffler helped J. G. Baker, Westinghouse engineer, pry into the secrets of vibration, a study which he continued with the toy boat, right, and with hundreds of other things. As a result of his work, big machinery may be freer of vibration

CHILDREN'S toys aided a recent scientific study of self-induced vibration, the phenomenon that causes wing flutter in airplanes and shimmy in auto wheels. To find its underlying laws, J. G. Baker, research engineer of the Westinghouse Electric and Manufacturing Company, investigated hundreds of examples of self-induced vibration. One was a toy walking man, that oscillates with a sideward motion when pushed forward; another, a toy boat propelled by water pulsing in and out of the hull, under the motive force of heat from an alcohol lamp. From his research, Baker concludes that the phenomenon can be prevented.

NEW PLEASURE CAR IS ALSO A LIGHT TRUCK

COMBINING a pleasure and a business car in one is the achievement of Peter Linn, Los Angeles, Calif., inventor. The rear end of the car is provided with a sliding deck, collapsible rumble seats and a folding trunk. To transform the car into a light delivery truck, deck and seats are pushed out of the way and the trunk unfolds to form a package carrier.



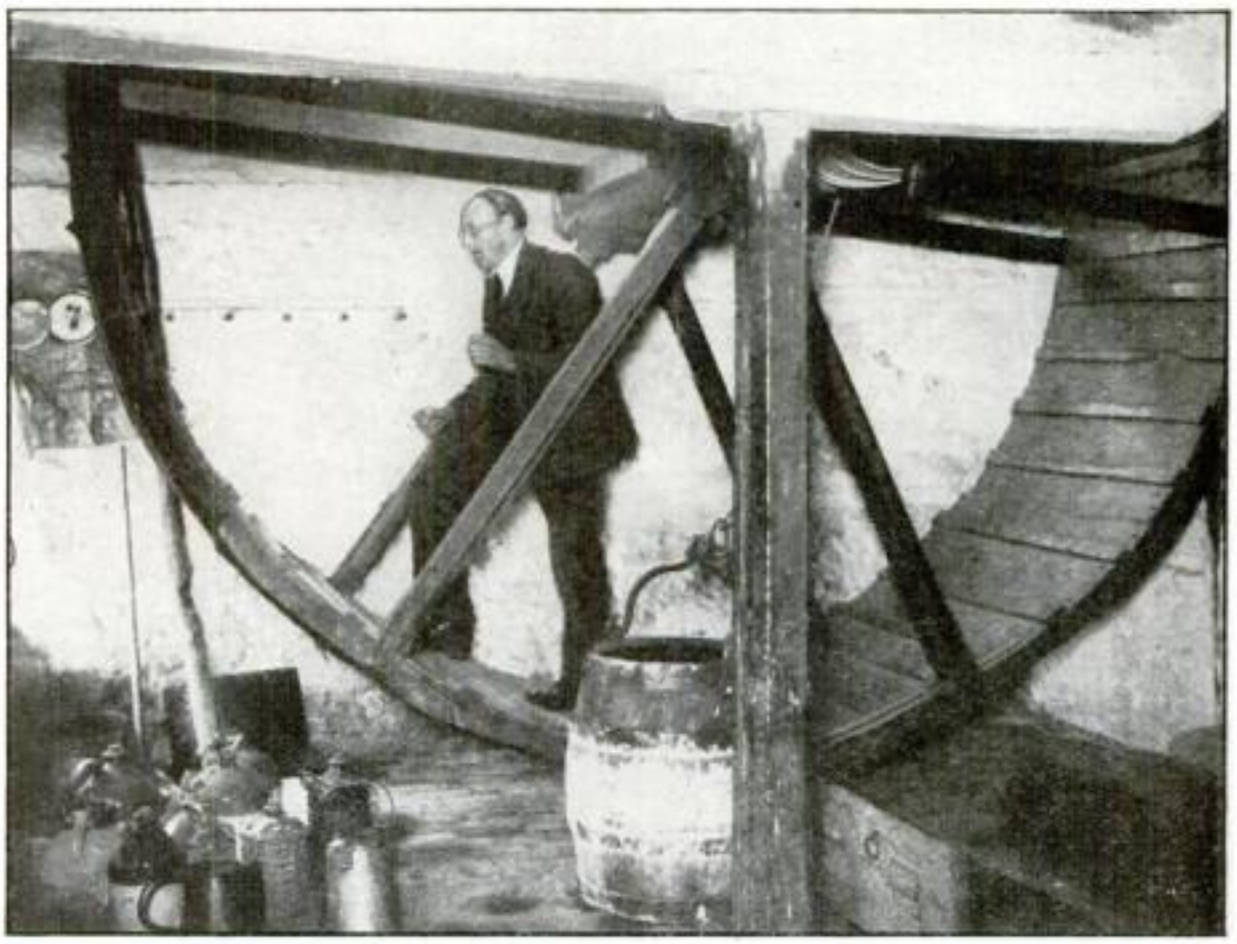
The pleasure car, for private use, shown in the circle, is easily converted into this light truck

MODEL OF HUMAN HEAD AIDS RADIUM RESEARCH

A LIFE-SIZE wax model of a human head is being used by a British hospital to test radium rays. Since the wax has about the same density as human tissue, the effect of radium upon any internal part may be measured by inserting a photographic film in the model.

WALKING IN TREADMILL DRAWS WATER

A BRITISH country dweller walks a quarter of a mile to get a drink of water, without leaving his own cellar! To raise the large bucket in his 300-foot well, Fred Hoare, of Beauworth, Hants, installed a twelve-foot treadmill beside the shaft. When he steps inside it to take his daily constitutional, a windlass puts his exercise to practical use and winds in the cable to which the bucket, shown in the photograph below, is attached. Thus he secures his daily supply of water.



Fred Hoare, of Beauworth, England, is drawing his daily supply of drinking water. He does this by taking his exercise inside the twelve-foot treadmill which winds up a cable from the well

The improvised dolly, below, is used by amateur movie makers to photograph scenes in which a moving camera is necessary. In the miniature airport set, in circle, note model moon rocket and the "stars" which are light holes in the drop

Amateur Movie Makers

USE PROFESSIONAL TRICKS

IN LITTLE HOLLYWOOD, the amateur cinematographers are shooting. Home-made floodlights blaze. Embryo Garbos appear. Miniature cameras click, as amateur directors wield megaphone and script to produce thrilling celluloid drama.

In the heart of Los Angeles's cinema capital, unknown to the general public is the Hollywood of the amateur moviemakers, whose activities, carried on in attics, garages, and parlors of private homes, are quite as intense and as interesting as the production of million-dollar films on the giant movie lots nearby.

Recently I visited a number of the leading amateurs in their improvised studios. I was shown comedies with trick shots in which dogs walked backward, magicians poured water from hats, and gorillas jumped twenty feet into trees; mystery pictures with thrilling laboratory scenes, shot in the offices of a friendly doctor; stories of big-game hunting in Africa, made at a nearby zoo, with trick effects added through the use of homemade props; and news reels of actual events, filmed from half-a-hundred striking points of vantage not covered by professional cameramen.

In this busy colony of amateurs, clerks on a monthly pittance rub elbows with financial leaders. Bookkeepers and bankers work side by side, exchanging ideas, and vying with one another in producing new photographic effects. Professionals are barred. All are as jealous of their amateur standing as any college football star; yet the results they achieve, using homemade equipment improvised from whatever is at hand, rival the work of Hollywood professionals with their elaborate equipment.

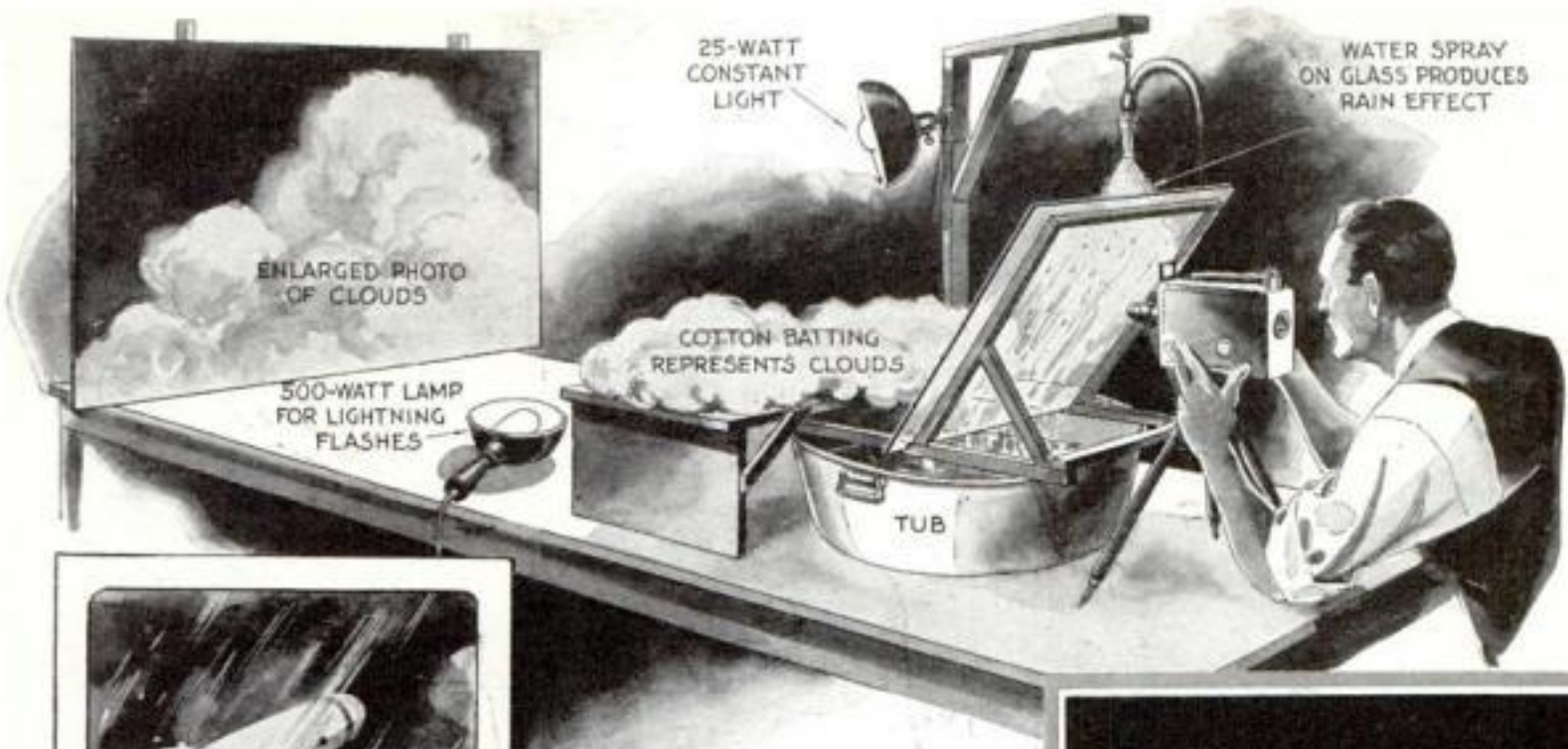
Seeking new thrills for readers of POPULAR SCIENCE MONTHLY, I was taken behind scenes to witness the filming of "The Lunar Expedition" by two Los Angeles amateurs, Harry Babb and Harold Knoblock. When I visited them in their studio, located in a garage in the rear of the lot, they had already been working on the picture, evenings and spare time, for seven months and still had much left to do.

The methods they were using were identical with some of the cleverest professional effects I have seen in the big studios nearby, and ranged from indoor settings, built accurately to scale, to miniature model sets, re-projection, and other difficult feats of the movies.

"Our first shot," young Knoblock told me, "is a night scene showing two explorers at an airport, ready to take off for the moon in a rocket. Naturally, real moon-rockets are scarce, so we built a miniature airport set, to scale. The rocket we made of metal, piercing the walls with a row of portholes and illuminating it from inside with a tubular showcase bulb.

"The main building at the airport was a hand-painted cut-out, with a black sky background suspended from pulleys overhead. Light from behind the scenes streamed through the windows and doors of the cut-out, and illuminated the tiny stars in the midnight sky. Two toy figures of policemen stood at the entrance to the building. The airport beacon was a dash-light bulb, flashed by hand. A fan at the side of the set stirred up a breeze that spun the propeller of a toy airplane on the landing field, and tossed the ornamental bushes planted in front of the airdrome.

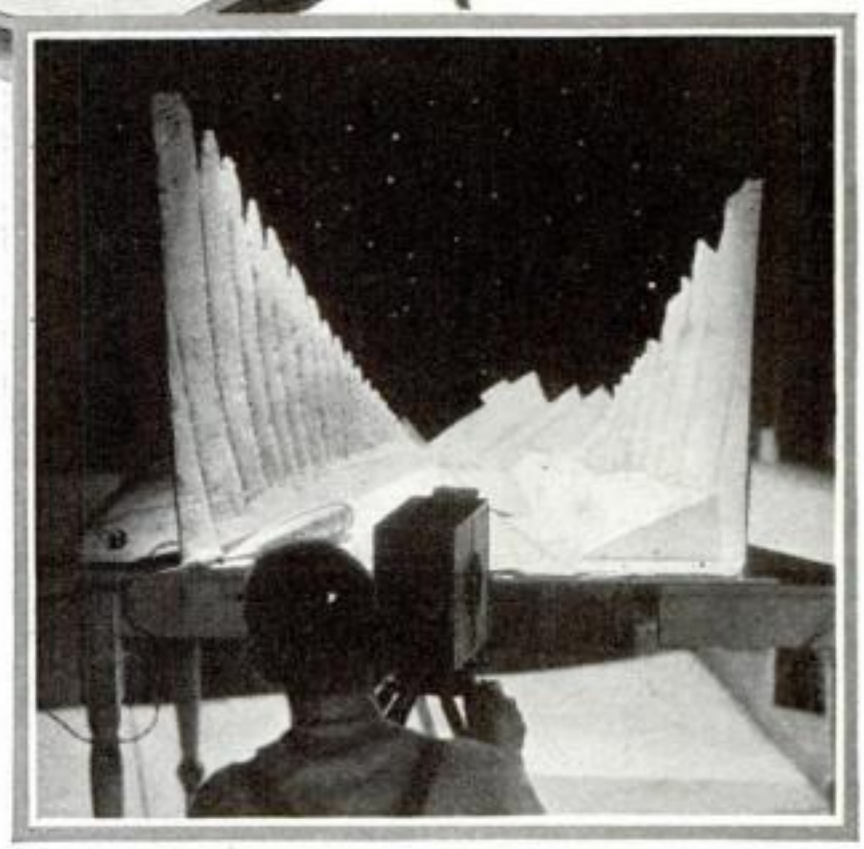
In its trip to the moon, the rocket passes through this storm. Light flashing through jagged cut produces the effect of lightning



HOW THE ROCKET FLEW THROUGH STORM

This drawing shows how the big storm scene in the trip to the moon was shot. Water falling down the glass in front of the camera became driving rain and cotton was clouds while a lamp flashed lightning. By double exposure this scene was photographed on film

FINISHED SCENE AS RECORDED BY CAMERA



With a spotlight in the ceiling, these imitation mountains of the moon, at right, were lighted up for filming as part of the rocket's flight to the moon

FILM Thrillers, Made in Attic or Garage, with Tiny Sets, Rival the Work Turned Out in Big Studios with Costly Equipment

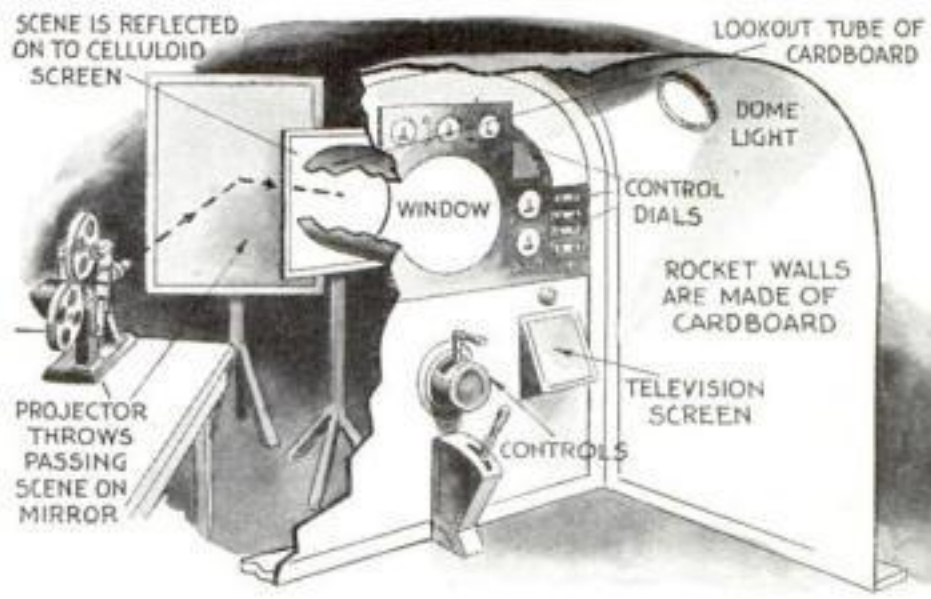
By STERLING GLEASON

"At this point in the story, action was transferred to the interior of the rocket. For these scenes we built two cardboard sets, each six feet high and five feet wide. These we fitted with controls made from radio dials and lighting fixtures. A toy telephone and a pair of glass panels represented television equipment.

"As the rocket rose, the actors, looking out, saw the airport recede and the stars come into view. This effect we achieved by lowering the background, allowing the buildings to pass out of camera view, and the stars to move downward, producing the illusion that the rocket was rapidly rising on its way to the moon.

"To get the effect of vision through a window in the nose of the rocket, we had to borrow the professional trick of re-projection. Eighteen inches back of the window, making it appear that the rocket had thick walls, we placed a celluloid

Making titles. These are hand-lettered on cards and photographed with a movie camera



To give realism to the rocket picture, views of its interior were made as illustrated in drawing, left. The storm through which rocket was passing was caught through the open lookout tube

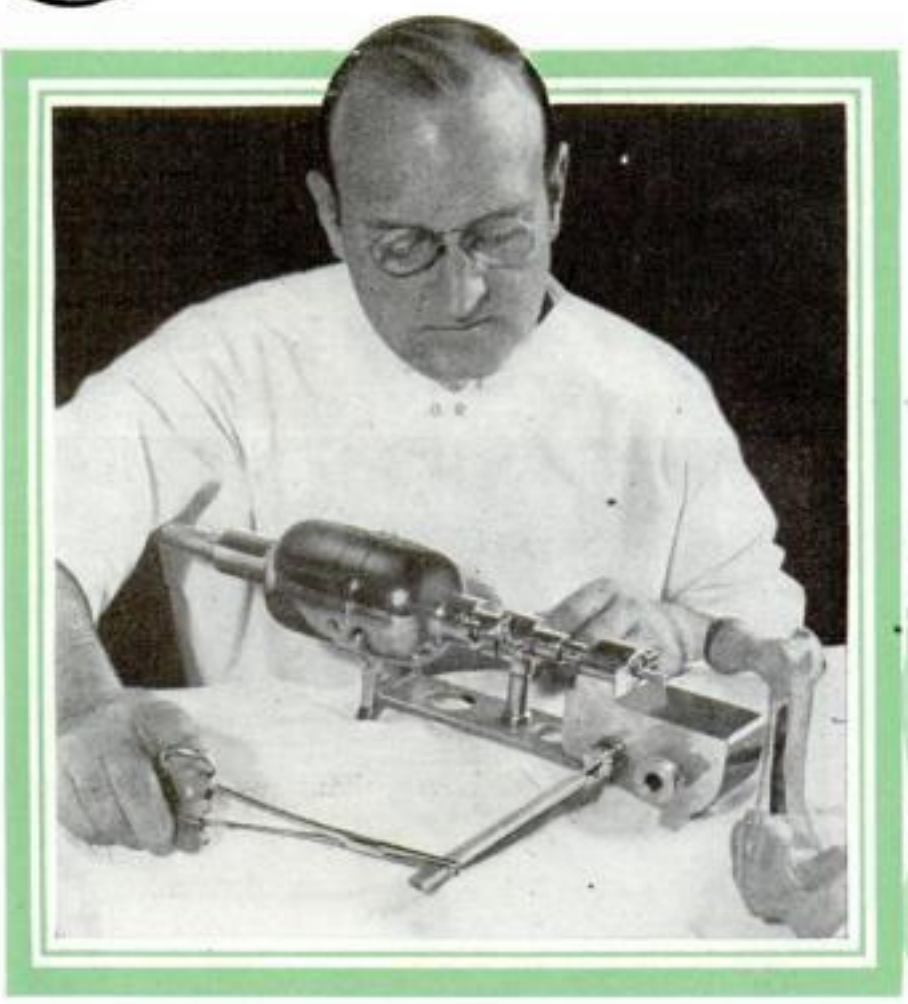
screen. At an angle we set a large mirror, reflecting to the surface of the screen the images thrown up by a projector, through which we ran films showing various scenic effects previously shot.

"One was a view of the moon, rapidly enlarging as the rocket rushed toward it. Another was a close-up of the mountains of the moon. More difficult to make was a scene in which the rocket passed through a terrific storm in the upper atmosphere.

"For this shot, we painted clouds upon a cardboard background, slit with a forked pattern. Flashing a light behind the scene produced a long, jagged tongue of lightning. On the floor of the set, we piled wads of cotton until the tops of the wisps showed in the camera as clouds beneath the rocket. For rain, we directed a fine spray of water toward the camera, which was protected by a pane of glass about eighteen inches in front of the lens. Thus we produced the effect of rain beating against the window of the rocket.

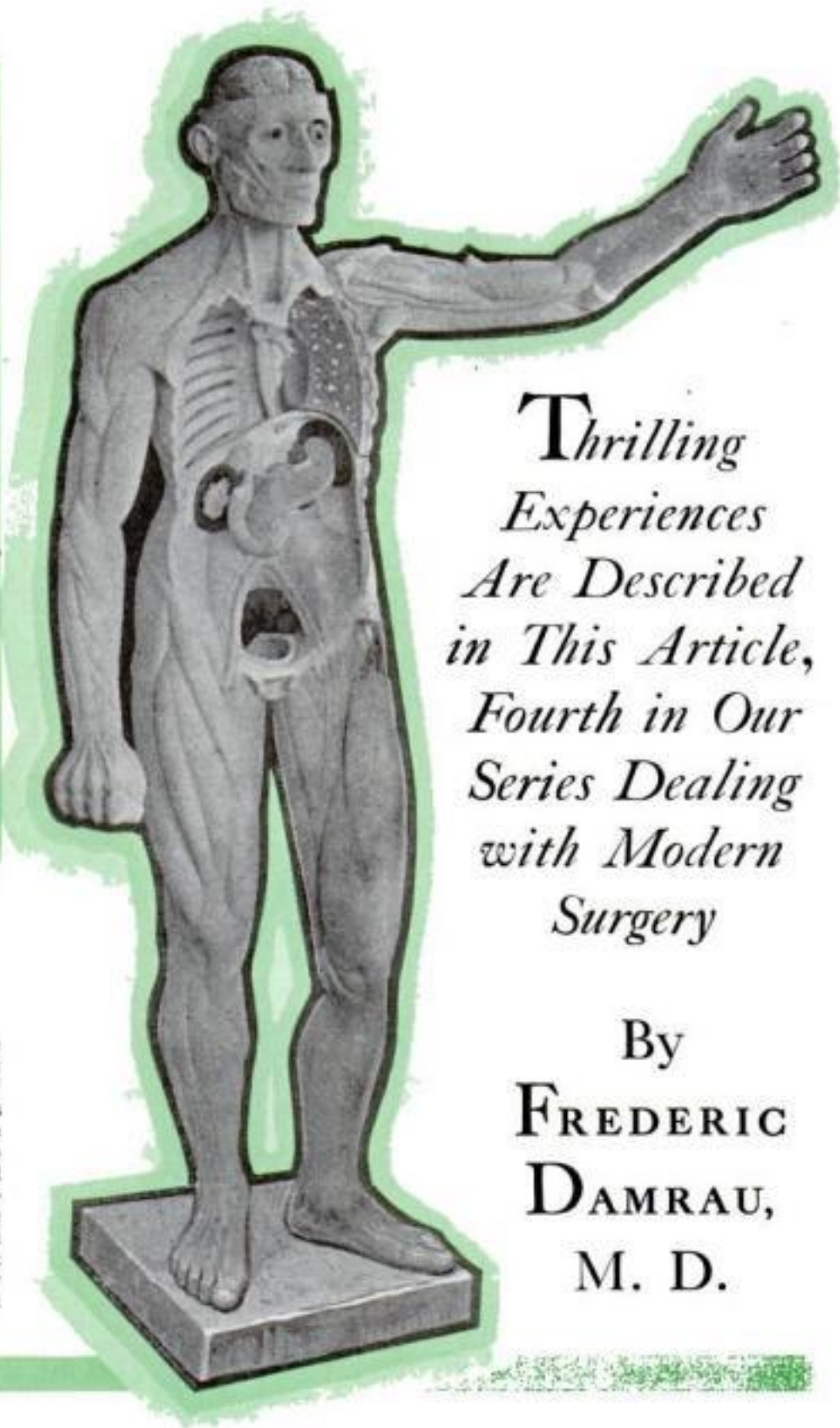
"This film, projected upon the celluloid window of the rocket set, made a telling accompaniment to the action of the story. Television effects were also produced by re-projection. When the hero pressed a switch to communicate with the earth, an image of the speaker at the other end flashed up on the television panel—coming, in reality, from the hidden projector behind scenes." *(Continued on page 101)*

Shattered Men Rebuilt



SHAPING BONE FOR HUMAN REPAIR JOB

With this high speed motor, a piece of shin bone is being shaped as a screw so it can be employed to repair a broken bone



This figure of the human body, used in the class rooms of medical schools, gives a suggestion of the amazingly intricate human machine and indicates the delicacy with which the operations, described in this article, must be performed in order to prove successful

Thrilling Experiences Are Described in This Article, Fourth in Our Series Dealing with Modern Surgery

By FREDERIC DAMRAU, M. D.

A DISTINGUISHED looking man stopped me on the street. "Remember me, Doctor?" he asked.

I looked at him closely. On each cheek there was visible the short line of a scar. Eventually he identified himself as a soldier I had treated in 1918 after he had undergone what was probably the most amazing human repair job I have seen performed.

His whole lower jaw had been shot away in the Argonne. Surgery had given him a new jawbone and had surrounded his comparatively uninjured tongue with an artificial mouth sculptured from transplanted, living flesh! Today, his only visible disfigurement is that inch or two of scar on either cheek!

How was this miracle performed?

First, the surgeon modeled an artificial jawbone from vulcanite, the hard-rubber compound used by dentists in making plates. This framework he screwed to the stumps of the jawbone. The next step was to construct a floor for the artificial mouth. The material used had to be mucous membrane like that on the inside of your cheek. The task seemed impossible until the surgeon hit upon the idea of using the cheek itself.

On the inside of each cheek, he cut a triangular flap. Then he turned down the two flaps and sewed them together. The result was a serviceable lining for the new mouth.

The last stage of the operation was the most sensational of all. The surgeon used the patient's own scalp as material for molding the chin and covering the artificial jawbone and the gap left in the cheeks. Across the top of the head, from ear to ear, he cut a strip of scalp, leaving it permanently attached just above each ear. This strip he slipped down in front of the face and over the artificial jaw and cheeks until it assumed the position of a wide chin-strap.

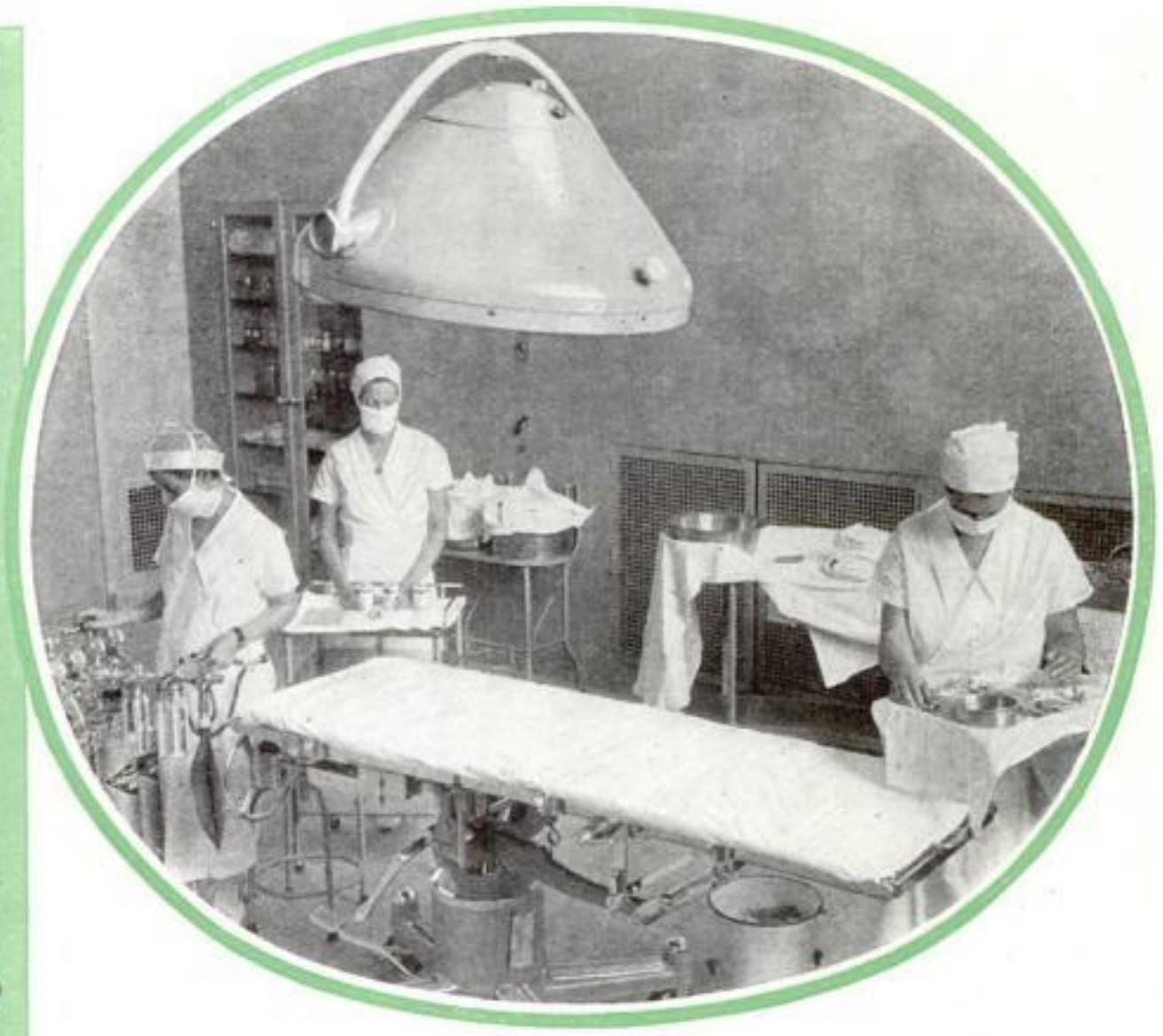
Then he molded it into place, stitching the scalp flap to the healthy skin of the cheeks and neck. Hair roots, carried in this transplanted material, produced a thick beard which later hid most of the scars left by the operation.

To fill the scalp wounds, skin grafts were taken from the patient's thigh, using two sharp safety-razor blades. By a lucky chance, his legs were coated with an unusually heavy growth of hair which, when transplanted to the scalp, played an important part in concealing the scars on the head. Thus, one topsy-turvy result of this amazing piece of surgery is the fact that the patient's beard came from the top of his head and hair now covering his scalp originally grew on his leg!

Such achievements of the operating room read like fairy tales; yet, they are matters of record. In the surgical reports of almost any large city, you will find similar wonder stories of human carpentry. Splicing living nerves as an electrician splices wires; dovetailing bones as a carpenter dovetails wood; sewing muscles in place as a seamstress sews cloth, the modern surgeon adjusts and repairs the human body. By applying the techniques of many trades, he helps the deformed, the disfigured, and the handicapped.

A remarkable instance comes from the Middle West. Here, a boy born without arms, can now through a miracle of surgery dress himself and even operate a typewriter!

by Master Surgeons



It is in a modern operating room like this in the big hospitals that the remaking of human bodies goes on. Illustration, left, shows that methods familiar to all mechanics are used by surgeons in their repair work on broken bones

Doctors who examined him at the time of his birth, could not find even the smallest stump of an arm. The case seemed hopeless. Then, when the boy was twelve years old, an x-ray showed that each armless shoulder concealed a small, undeveloped piece of arm bone, three inches long on the right side and four inches long on the left.

Basing his plan upon this discovery, Dr. Harry E. Mock, a Chicago, Ill., surgeon, decided upon a daring experiment. He would free the two rudimentary arm bones hidden under the shoulders and sew powerful chest muscles to them in the hope that Nature would develop them into useful stumps.

Beginning on the right side, he made two four-inch incisions below the shoulder and reached the hidden bone. It was shriveled and no thicker than the wrist bone of a two-year-old child. Carefully cutting it free, Dr. Mock pulled it outward to an angle of thirty degrees. The first step in the operation was over. The next was even more delicate.

To supply muscles to move the bone, as your biceps bends your elbow, the surgeon freed one end of powerful chest muscles. Next, he laced them to the outer layer of the bone, using strong braided silk. Finally, he covered the stump with grafted skin and let it heal.

Two weeks later, the rudimentary bone under the left shoulder was released by a similar operation. The boy now had two stumps for arms. But he was unable to move them in all directions. A physiotherapist, expert in muscular troubles, was called in. He worked out special exercises to train the chest muscles.

Day by day, the power and flexibility of the stumps increased. By the time the boy had gained full control of them, he was ready to be fitted with artificial arms. He soon learned to use these so expertly that he can take care of himself and even write letters on an ordinary typewriter.

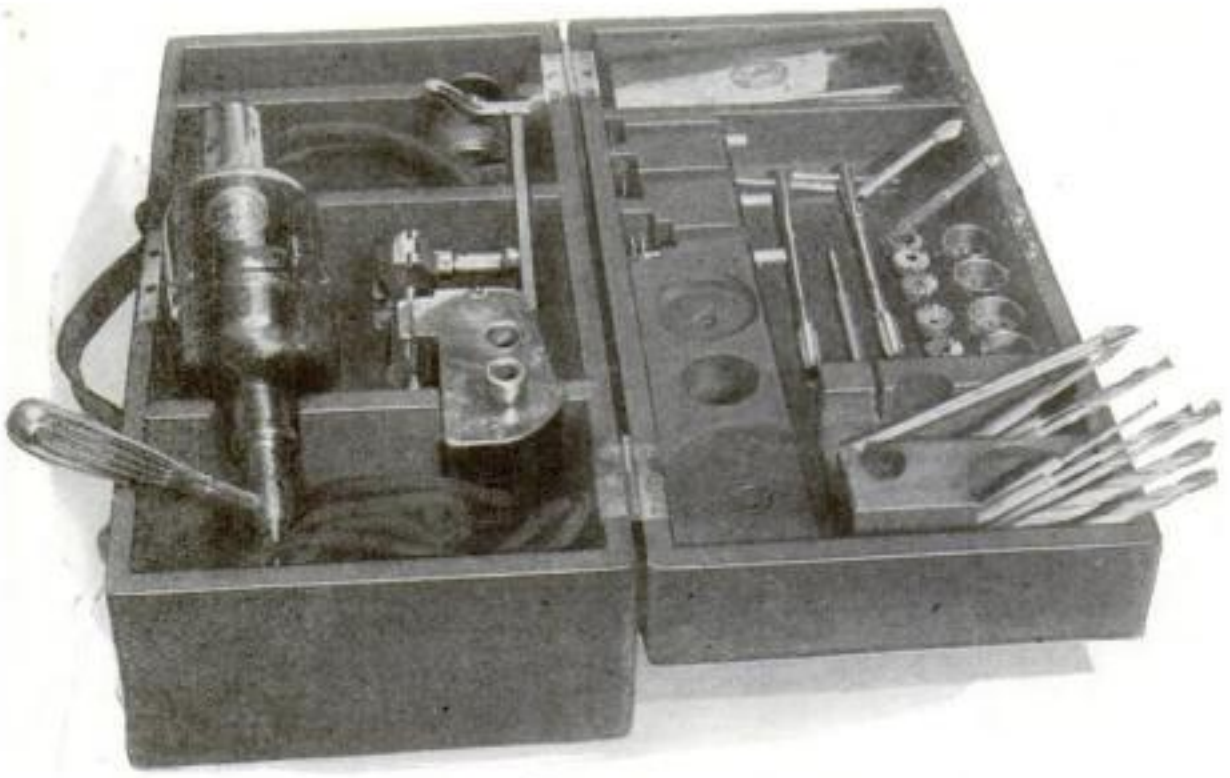
Another unusual operation saved the arms of a sixteen-year-old girl at Omaha, Neb., only a few weeks ago. When her left arm and hand began to shrivel mysteriously, X-ray pictures were made of her chest and shoulders. They revealed two extra ribs pressing down on nerves which controlled the left arm. The superfluous bones were removed by a surgeon and the trouble disappeared.

In the operating room, surgeons must be constantly on the alert for abnormalities in anatomy. Human bodies are not like automobiles. The surgeon cannot count upon the parts always being in the same place. In England, for example, there is a club with half a dozen members, all having their hearts on the right side. At Poplarbluff, Mo., not long ago, a seven-year-old girl, in perfect health, was found to have her heart and liver on the wrong side and her stomach put in backwards!

I have known patients with only one kidney and with the spleen on the right side of the body instead of the left. Young surgeons are always warned to watch for signs of appendicitis on the left as well as the right side of the abdomen. A number of cases are on record of people whose appendices were thus transposed. Again, a certain percentage of patients have anomalous arteries that follow other than normal paths. In cutting into the body, the surgeon always proceeds cautiously to avoid slitting open such a blood channel found in an unexpected place.

Repair work on arteries is one of the most ticklish tasks a surgeon has to face. Yet, in Paris, not long ago, the French surgeons, M. Payer and M. Lambret, actually joined two arteries together, as a plumber might join pipes, to form one continuous channel for the bloodstream.

Their feat was part of an operation which ranks among the most spectacular



Here is the tool chest of the modern bone surgeon. Note the great number and variety of instruments, among them bits, saws, taps and dies, drills—practically everything that would be found in the tool chest of a good mechanic

in all medical history. A fifteen-year-old boy had lost his right thumb by catching it in the gearing of a machine. Ordinarily, he would have been handicapped for life, But, by a piece of surgical wizardry, the Paris doctors repaired his hand, making a new thumb out of his big toe!

This remarkable operation was carried out over a period of two weeks. The ligaments had to be connected and allowed to grow together. The veins and arteries of the big toe had to be sewed together with those of the palm. Nerves had to be spliced. And, finally, the tendons of the big toe had to be hooked up with those of the forearm so the thumb could be moved as desired.

During all this time, while the big toe was growing onto the hand, while it still remained attached to the foot, the hand and foot were bound together to prevent any movement that might disturb the delicate tissues knitting together. The position was uncomfortable, but the result justified the pain. For the grafted toe enabled the boy to hold a pencil and write legibly and later tests indicated that in muscular power and sense of touch, the remarkable toe-thumb was entirely normal.

A British surgeon, Lieut.-Col. Sir Robert Jones, describes another operation in which a lost thumb was replaced by a finger removed from the good hand. In due time, it grew in and could be used in much the same way as the original thumb.

The reverse of these operations, a case in which a man lost all four fingers in an accident but retained his thumb, resulted in an equally dramatic piece of work by the famous New York surgeon, Dr. Fred Albee. As the thumb was useless without a finger against which to work, Dr. Albee created a finger out of a pencil of bone wrapped around with living flesh and planted on the hand.

The bone was cut from the patient's own shin-bone so it would be of the right type to knit with that of his hand. Rapidly, it was shaped on a miniature lathe, given a screw thread at one end, and then screwed into an opening drilled in the bone at the base of the missing forefinger. A flap of flesh, from the patient's abdomen, which had already been stitched to the stump of the hand, was molded around the bone and sewed up. In time, the bone grew solidly to that of the hand, and the finger, although it had no joint, enabled the patient to button his clothes and handle tools.

Because grafted bones must be transferred quickly and must be of the same type as the rest of the patient's bones, they are usually taken from his shin. For this reason, bone surgeons often refer to the shin as the human lumberyard. In a few months after a piece has been removed, new bone forms and fills in the gap.

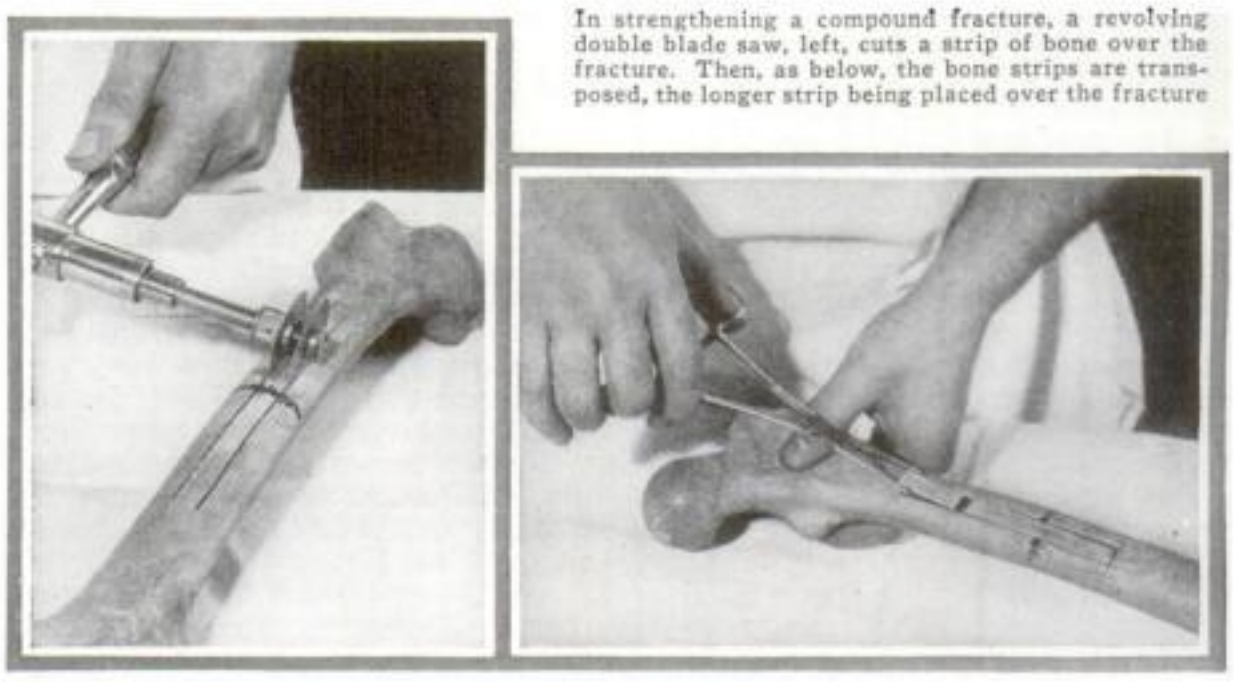
A year or so ago, I saw a man with a glass eye and a surprisingly natural eyelid made from the skin of his forehead. In a hunting accident, he had been shot through the eye. Although the eye was destroyed the bullet luckily took a slanting course and missed the brain. But it tore the eyelid to pieces, giving him a gruesome appearance. A New York surgeon created the new eyelid by cutting a flap in the forehead, trimming it to the proper shape and turning it down over the eye cavity. A skin graft filled in the place from which the flap was cut and the remarkably successful repair job was complete.

In curing cross-eyes, tiny ocular muscles are surgically tucked or advanced to remedy the defect. The trouble is caused by the muscle attached to one side of the eyeball being shorter than the one on the other side. The eye is turned to the side of the shorter muscle. To equalize the pull of the muscles, the surgeon either sews a tuck in the longer muscle to shorten it or he cuts it loose from the ball of the eye and advances it to a new position farther forward, where it is sewed in place with surgical silk.

By shifting the position of a tendon from the back of the leg to the front, the surgeon can sometimes aid those who have been attacked by infantile paralysis. I know a young dentist who had infantile paralysis in 1916. As a result, his right foot dragged when he attempted to walk. For years, he wore braces to hold up the tie of his shoe. Then a simple operation was performed. The tendon of one of the large muscles of the back of the leg, which was not paralyzed, was switched around to the front of the leg and fastened with kangaroo tendons to the tough membrane beside the anklebone. Here it took the place of the paralyzed muscles along the shin bone, allowing him to raise the previously useless foot at will. In cases of slight paralysis, doctors sometimes employ a steel spring attached to the heel and sole of the shoe to prevent the toe from dropping. But, by the surgical tendon-shifting described above, a permanent cure is often effected.

Another dramatic phase of the human carpentry which goes on in the operating room is the *(Continued on page 97)*

To insert a piece of bone to hold two broken parts together, the repair bit is shaped as a screw and it is then screwed into holes drilled in broken parts



In strengthening a compound fracture, a revolving double blade saw, left, cuts a strip of bone over the fracture. Then, as below, the bone strips are transposed, the longer strip being placed over the fracture

Making Our MONEY *Last Longer*

Worn out U.S. bills, after they have been reduced to bits in a chopping machine, are shoveled into a furnace and burned. Experiments are now being made to find a process of making writing paper out of these bills and so end this big waste

With this stretching machine, a sample of paper, indicated by the arrow, is tested to determine its tensile strength. A record is made of the force necessary to break it

Constant Tests by Our Government Seek More Durable Paper Currency

By ARTHUR GRAHAME

HOW I wish I could make my money last longer!" We've all expressed that universal desire.

The United States Government is wishing the same thing—that it could make its money last longer. Even now, it does a lot better than most of us for it makes a dollar bill last nine months! But the Treasury Department isn't satisfied with the average life of our paper money, so scientists in the Bureau of Standards, Washington, coöperate with the money makers of the Bureau of Engraving and Printing in a never-ending search for a more durable paper on which to print the government's promises to pay. Also they are in search of a more nearly impervious coating with which to protect them against the inevitable use and abuse to which they are subjected.

No earlier paper money ever met the gruelling wear that the small-size dollar bills, forming about sixty per cent of our paper currency, must endure. Modern life has increased the activity of the dollar. The automobile is guilty of shortening the life of many a bill. Out of every three persons living in the United States, one drives a car. Naturally, millions of our bills pass through the hands of persons whose hands are covered with oil and grease, damaging to the toughest paper currency that can be manufactured.

As they are printed on both sides, bills must be opaque and this instrument tests paper's ability to prevent the passage of any confusing light

A bill leads a hard life! Folded in wallets, curled in rolls, carelessly crumpled in pockets, stained by oil or eaten by acid, often wet, the wonder is not that it lasts only nine months, but that it remains serviceable for that length of time before it must be returned to the Treasury Department and destroyed. But our federal currency makers hope for the perfection of new processes that will make it possible for them to turn out bills even more durable than those now in use.

"Our present paper money is satisfactory," Alvin W. Hall, director of the Bureau of Engraving and Printing, told me, "but we always are trying for something even more satisfactory."

Much already has been done. Several years ago papermaking experiments conducted by the Bureau of Standards resulted, without additional cost to the government, in a forty per cent increase in the life of paper money. Now the search

Millions of Bills Destroyed Each Year Keep Men Busy

To find out how much wear and tear our paper money will stand, a sample is placed on an electric rubbing machine where the number of rubs needed to wear it through is automatically recorded. This supplements a hard folding test

How much force is needed to burst through a bill? With the machine, below, glycerin is forced against the paper and the force required to burst it is recorded by automatic gage

In the container which floats on water, paper is placed, sealed above a small hole. On the sample being tested, dye is scattered, to color the water when it comes through. The paper now used keeps out the water for one minute

is for some new overcoating for the bills that will be even more effective than the animal glue sizing now used. Bureau of Standards experts, led by B. W. Scribner, are experimenting with various other paper sizings, such as casein, lacquers, cellulose, and waxes.

The paper on which our currency is printed is made from pulp obtained by cooking linen and cotton rags, waste products of the garment-making trades, in a solution of either lime or caustic soda. Almost all of the linen rag used in paper making is imported, while all the cotton rag is of domestic origin. The mixture now used is seventy-five per cent linen and twenty-five per cent cotton.

Experiments are now being made in the testing laboratories to determine the maximum proportion of cotton that can be used in paper-money manufacture without decreasing the strength and durability of our bills. Bureau of Standards specialists believe it is possible to increase the cotton fiber content without sacrificing quality or strength. Already paper of excellent quality has been made from a fifty-fifty mixture of linen and cotton.

While a change from rag paper to wood fiber paper for bills is unlikely, such a change might be necessary in some national emergency, and experiments are being made with the better grades of wood fiber papers to determine their value as paper money. New recipes and formulas are constantly used in the making of experimental currency paper in the Bureau of Standards' paper making mill. These products are turned over to the government's printing experts who determine their suitability for paper money.

Several interesting tests are used by the Bureau of Standards to determine the fitness of these various papers.

The ability of paper to resist moisture is determined by finding with a split second stop watch, the time required for water to soak through the sample. Small pieces of paper are mounted in aluminum floats which are launched in shallow containers of water. There is a hole in the bottom of each float, over which the specimen to be tested is clamped. A mixture of sugar and chemical dye is sprinkled on the upper side of the paper, and covered with a small glass. When the water soaks through the paper and comes in contact with the dye, a bluish-purple discoloration results. Currency papers resist the passage of moisture for at least one minute.

The tensile strength of currency papers is found by stretching them on the opening jaws of an instrument that has a pendulum to record the force necessary to break the paper.

To determine the bursting strength of paper, a sample is held, under tension, against the rubber diaphragm of an instrument that has a hand wheel to pump glycerin against the diaphragm. A recording gage registers the rupture pressure.

An indication of how paper currency will stand up under the wear and tear of daily use is provided by testing paper samples in an electric rubbing machine that continuously rubs the paper back-and-forth until its surface is worn through. A counting attachment keeps tabs on the number of rubs the paper will stand.

Another electrical testing machine makes it possible to determine the folding strength of paper money. The sample, under tension, is pressed over rollers again and again until it fails, every folding of the paper being registered. When tested at standard humidity, our present paper money will withstand 5,000 such foldings before it breaks!

The importance of making our money last as long as possible is shown by the fact that between 5,000,000 and 6,000,000 pounds of currency wears out each year, and must be replaced by new bills. Last year over 900,000,000 used-up bills were destroyed by the Treasury Department.

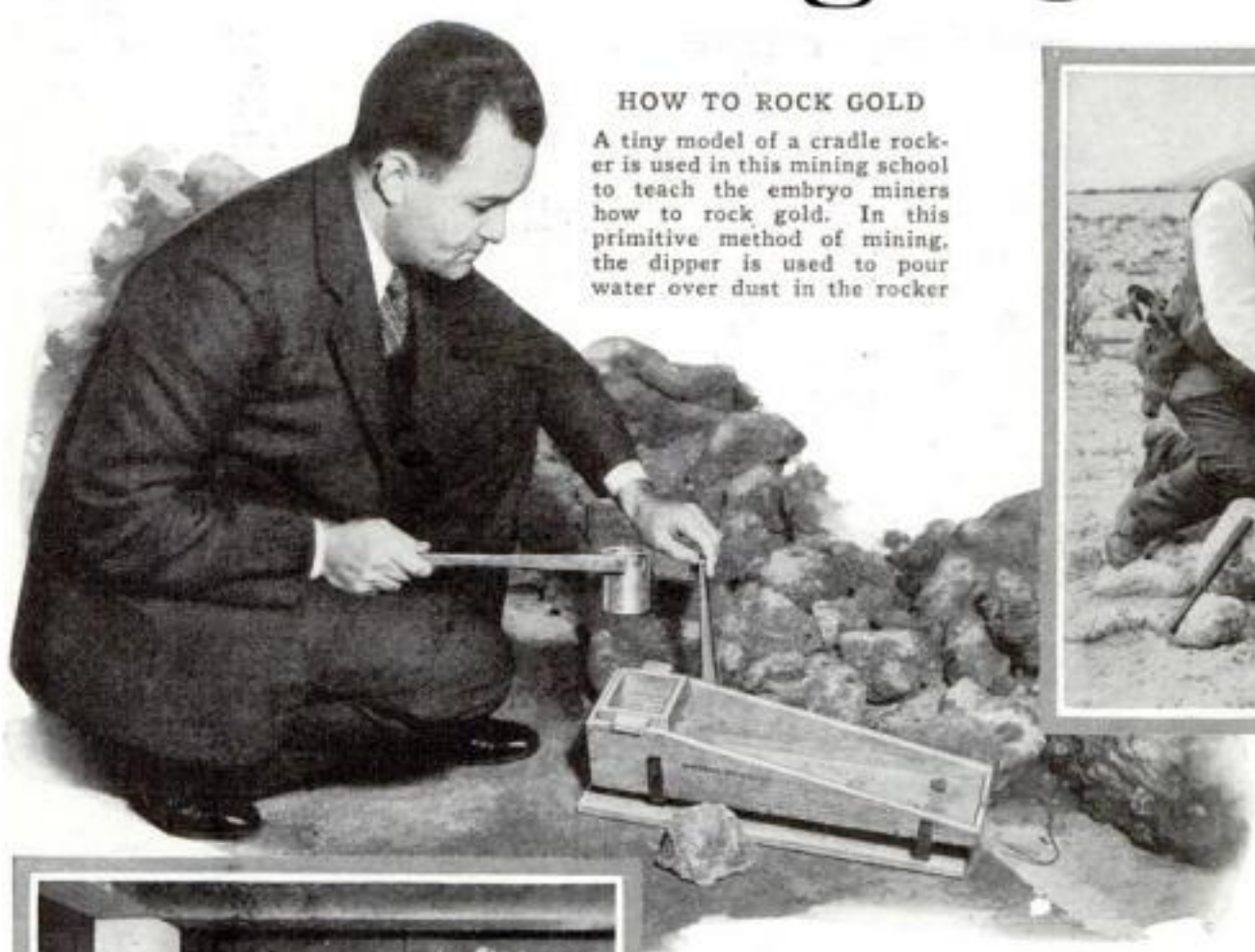
The process of replacing old paper currency is continuous. Each business day, the twelve Federal Reserve Banks in various sections of the United States remove from circulation the worn-out bills that come to them, and replace them with crisp, fresh notes.

The old bills are stacked face upward, and cut in half. To discourage attempts at robbery in transit, one stack of halves is shipped to Washington that day, and the remaining stack of halves is shipped the next day. At the Treasury Department, the halves are checked against each other, placed in sealed trunks, and sent to a machine that chops them into small bits as the first step in destroying them.

These bits are shoveled into tanks containing a solution of caustic soda. From the tanks, bills, once representing a tremendous fortune, emerge in the form of a gray, mucky pulp, most of which eventually is burned, although now and then a customer is found for a few carloads of it. An experimental salvage plant is being built at the Bureau of Engraving and Printing, and it is hoped that it soon will be possible to clean the pulp and make writing paper of it.

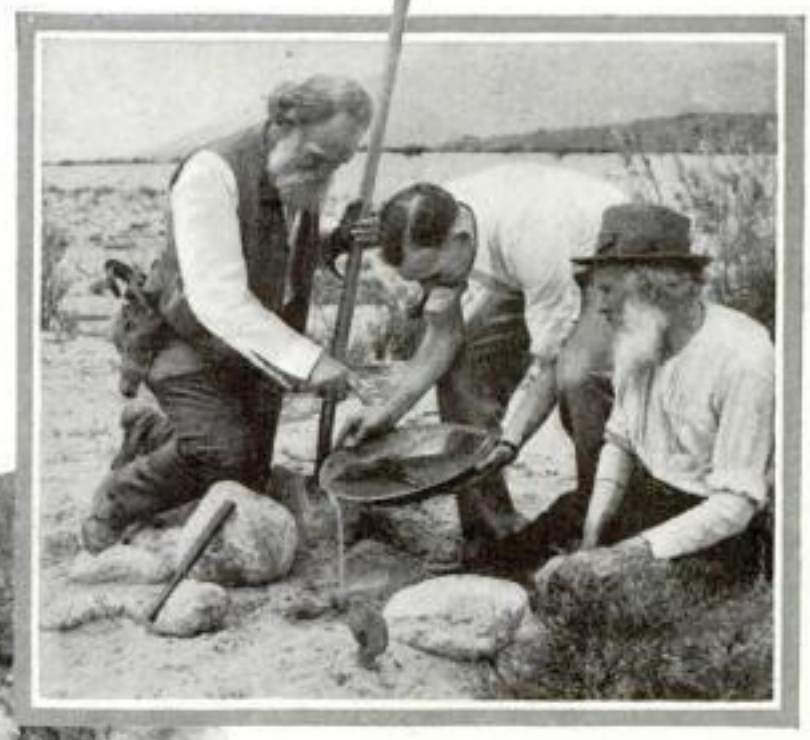
Ever since 1862, the government has used distinctive *(Continued on page 98)*

Gold Mining *taught with Models*



HOW TO ROCK GOLD

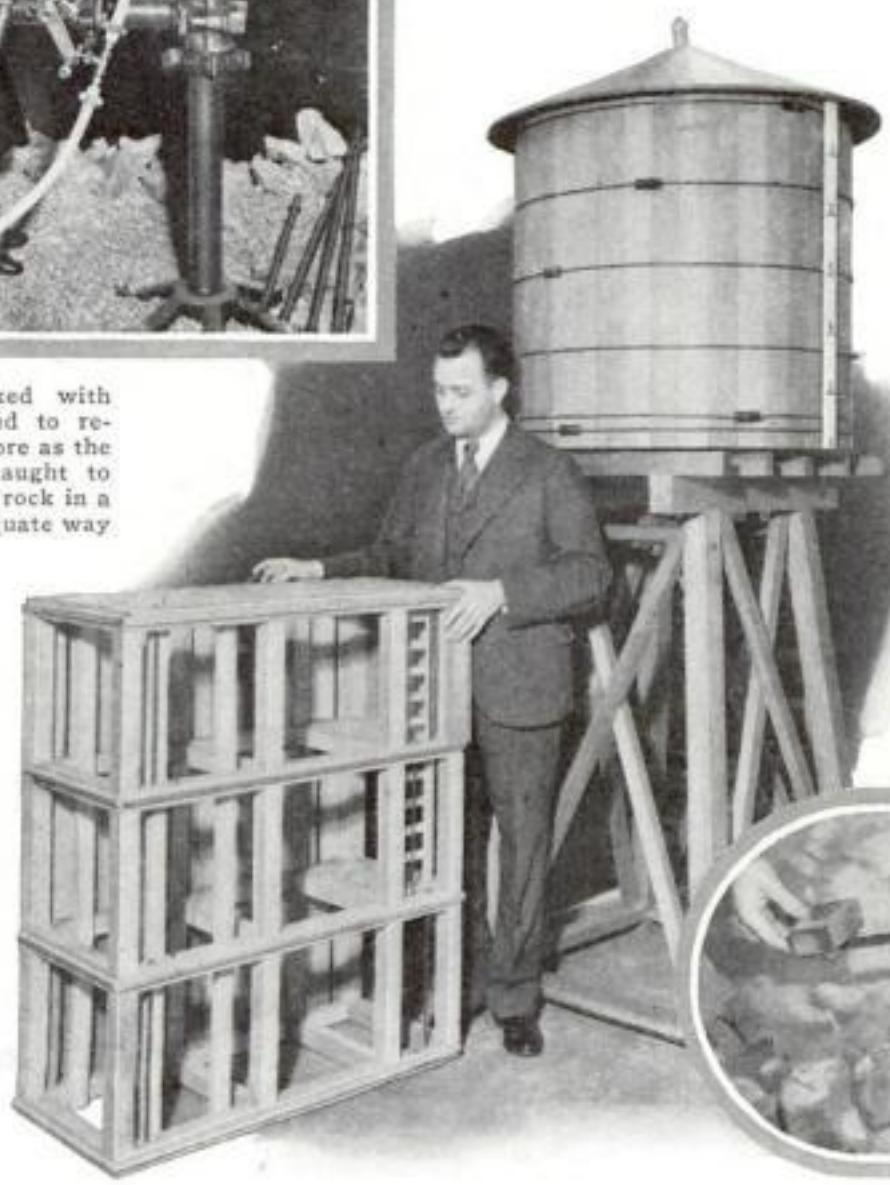
A tiny model of a cradle rocker is used in this mining school to teach the embryo miners how to rock gold. In this primitive method of mining, the dipper is used to pour water over dust in the rocker



Back in 1849, when California's gold fields were first worked, prospectors used the pan to recover gold. Times have changed but many amateur miners are still panning out their gold dust

Black paper, streaked with yellow paint, is used to resemble gold-bearing ore as the mining student is taught to drive a drift into the rock in a professional and adequate way

TINY cradle rockers and nozzles no longer than a man's arm aid in teaching amateur miners how to recover gold from the claims now being worked in the West. The oldest method known to mining and the newest are combined in this school at Los Angeles, Calif. After this course in the practical methods of recovering gold by cradle rocking or placer mining, students are ready to pursue their quests. They are taught to build water towers and they make models of several-compartment shafts. They learn how to operate automatic ore weighing machines and to handle air-driven drills. In a miniature model mine, they learn to drill and a make-believe horse stands still as they adjust harness and fasten on packs of food and tools.



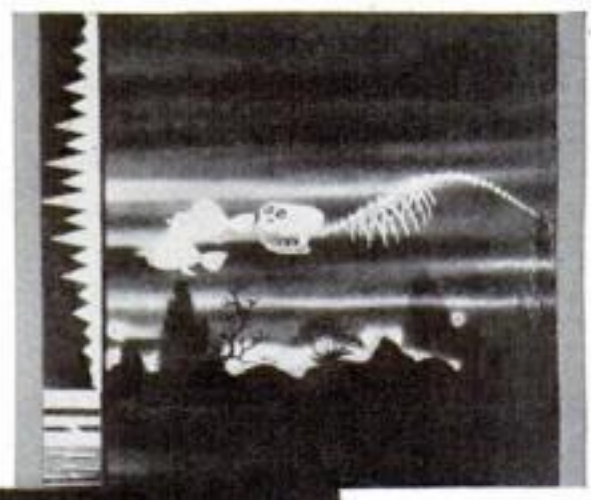
Model water towers and shafts, tiny in comparison with the real things, are set up and used to give the students an idea of how such things are built. In this way, they learn the technique of mining

This model of a horse is used to teach the would-be miners how to put on a harness and load their packs of food and tools. On the long trail, they will use a burro. At left, a model nozzle with which students are given the method of placer mining

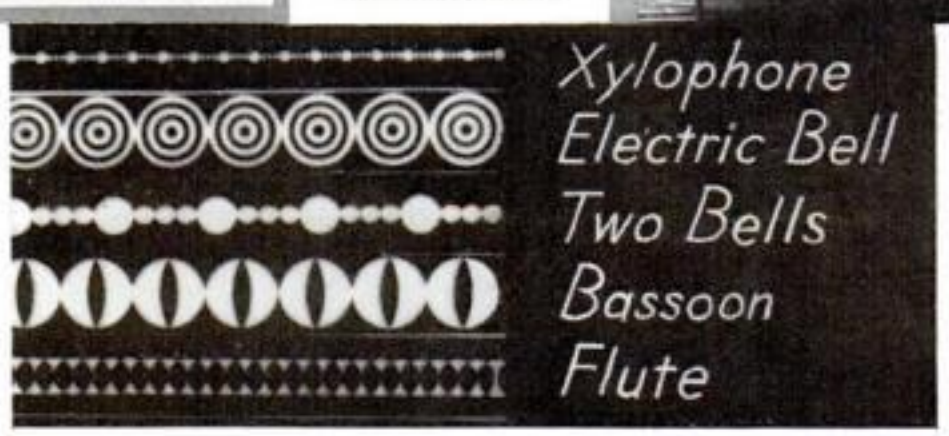
Odd Designs on Film Turn to Music

SYNTHETIC music is being produced in a German film studio by reversing a familiar process. When artists sing and orchestras play before the talkie microphone, their music is recorded, in one standard method, as a wavy black line upon the sound track of the film. What would happen if an artist were to draw arbitrary shapes, imprint them on sound film, and run it through a reproducer? A German technician, Oscar Fischinger, recently tried the experiment with startling results. A series of concentric circles, drawn in a strip and photographed upon sound film, imitated an electric bell. Eye-like spots reproduced a bassoon, and a pattern of dots sounded like a xylophone. Varying the size and shape of the singing ornaments produced tones that varied correspondingly in loudness, pitch and timbre, and they could be recorded consecutively to form a synthetic tune. Even the human voice could be mimicked. Fascinating possibilities await perfection of the method, which American experts compare at present to "the first crude stages of television." Will the composer of other days, seated at his piano and jotting notes upon a staff, give way to the draftsman at his table? Equipped with drafting tools and photographic apparatus, a composer could record his masterpieces eliminating the possibility of misinterpretation by an inexpert performer.

The odd geometrical designs, seen at the left drawn on long strips, are being photographed upon sound movie film. When the film is run through a reproducer, the lines will make music, differing according to the shape of the pattern. At right, an animated cartoon bearing hand made music



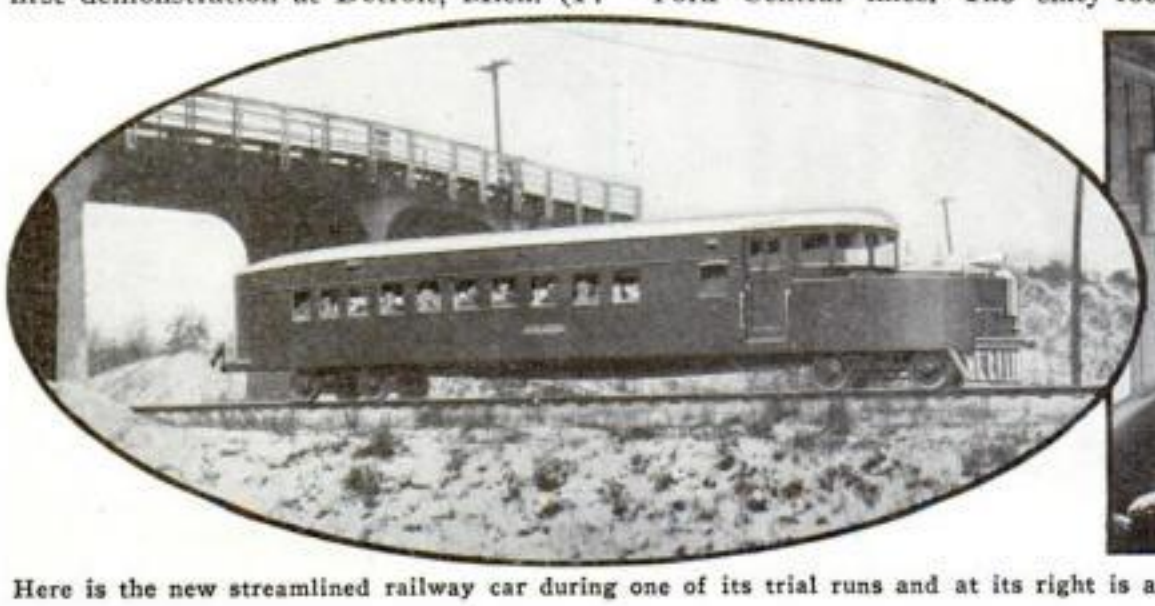
The same note, in the designs below, is drawn, top to bottom, to sound loud, soft, medium

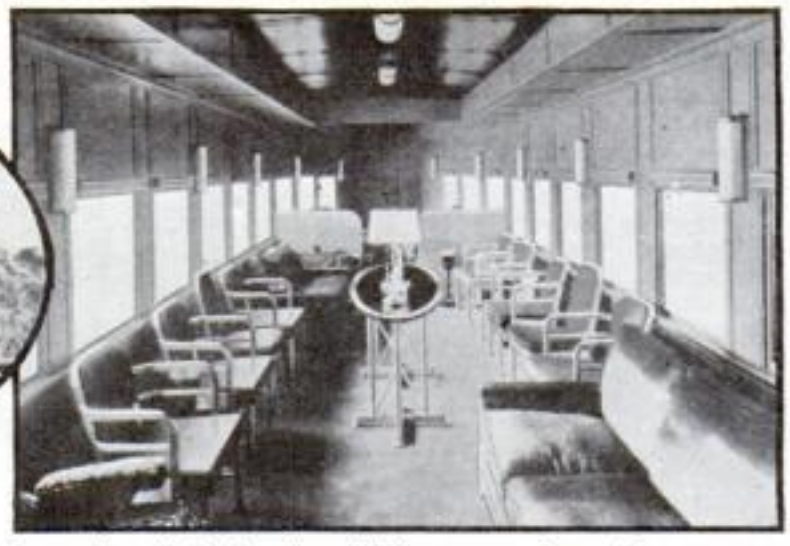


When these curious ornaments at left were photographed upon the sound film and run through a reproducer, they resulted in music as though from the instruments indicated

Final Tests Now Being Made of America's Fastest Railway Car

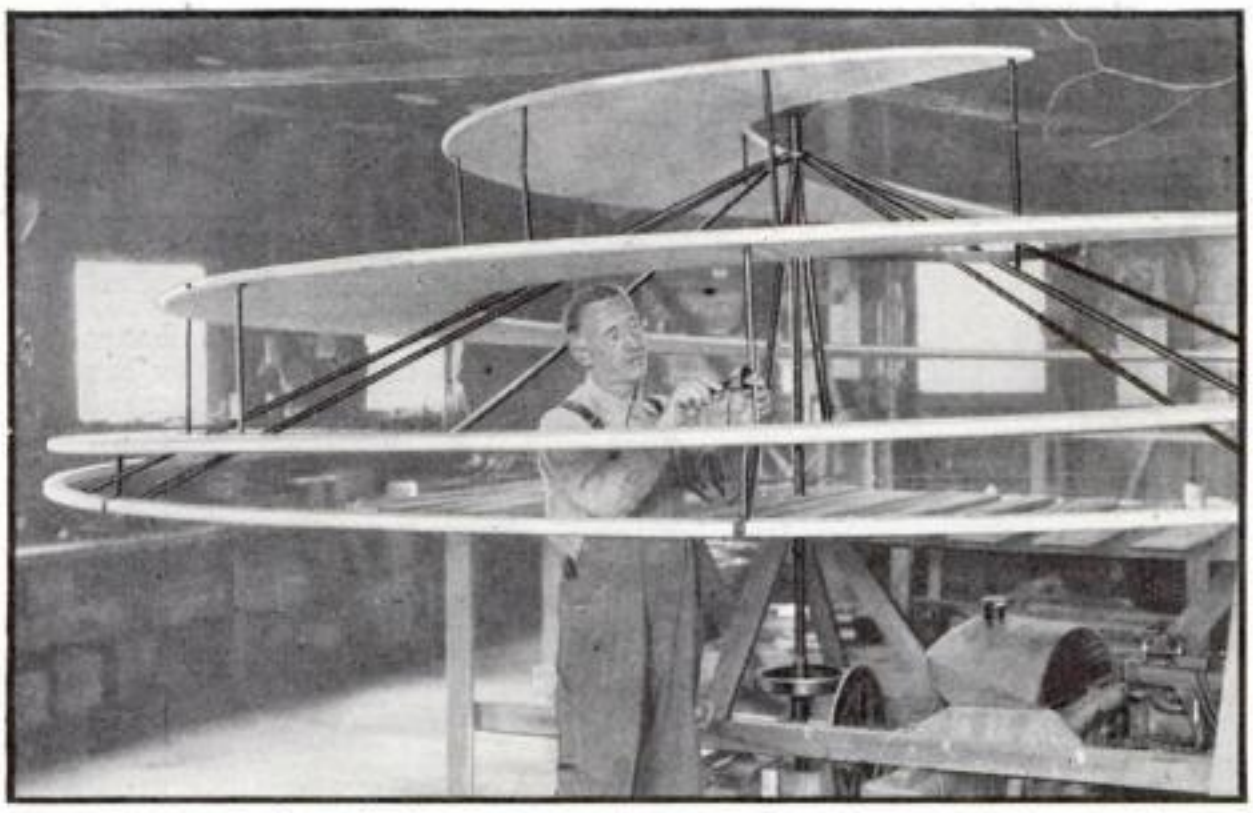
SOON to be seen in many states is the eighty-five-mile-an-hour streamlined railway car of aluminum that recently had its first demonstration at Detroit, Mich. (P. S.M., Feb., '33, p. 21). It has just begun a series of trial runs that will take it over tracks of the Michigan Central and New York Central lines. The sixty-foot car accommodates forty-two passengers in its heat-insulated and air-conditioned interior. It is powered with a sixteen-cylinder gasoline engine.





Here is the new streamlined railway car during one of its trial runs and at its right is a view of the interior which accommodates 42 passengers

Corkscrew Plane for Vertical Flight



J. P. Sellmer, of California, is shown with his working model of a corkscrew plane that he expects to rise vertically. Practical tests of the strange machine will be made soon

CAN an airplane be built that will fly straight up? Many odd crafts have been built in vain attempts to solve this problem, but J. P. Sellmer, of Stinson Beach, Calif., is pinning his hopes to one of even stranger design than most. His corkscrew airplane, according to him will lift itself by means of a whirling, continuous wing of spiral design. A small propeller will keep the framework from spinning. Though aviation experts offer the idea little encouragement, Sellmer is busily putting the finishing touches to a large model with which he will test his theory.

TELESCOPE EYEGLASSES MAKE THE BLIND SEE

TELESCOPE eyeglasses, just perfected by a New York optometrist, will enable forty percent of persons incapacitated by blindness to return to normal work, the American Academy of Optometry was told recently. The powerful lenses enable a patient with only two per cent of normal vision, ordinarily classed as total blindness, to see clearly. Because of their high power the glasses distort objects slightly.

NEW MACHINE GAGES MAN-MADE QUAKES

To STUDY the transmission of earthquake waves through the earth's crust, German meteorologists are setting off artificial explosions. An apparatus called an "undograph," illustrated above, is used to detect the tremor. In one test a ton of high explosive was fired on an Arctic island and over three hours later the shock was detected at Potsdam, Germany.

AIRPLANE TESTS AUTO'S VENTILATOR

A GALE from an airplane propeller was used in a recent striking test to show the efficiency of a new ventilating system for automobiles. By utilizing air currents set up by the car's motion, the system provides individual ventilation to suit the comfort of each passenger. Fresh-air lovers may enjoy the breeze without making other occupants shiver. The secret of the air-conditioned car is a set of special windows, split vertically, so that one half is raised or lowered in the usual way while the other half swings on a pivot to prevent drafts striking the occupants of the car.

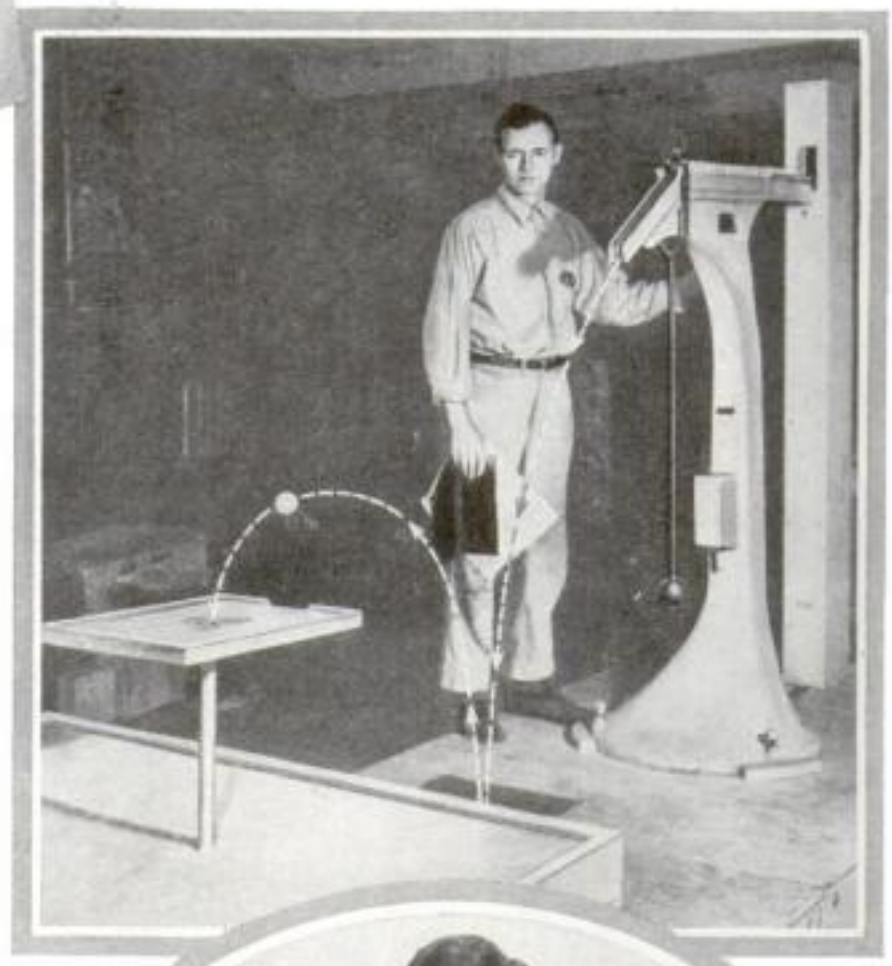
The vertically split window, seen in the circle, is the secret of a new air-conditioning system for autos that, in the picture above, is being tested in the blast from plane's propeller

Home Utensils Guarded

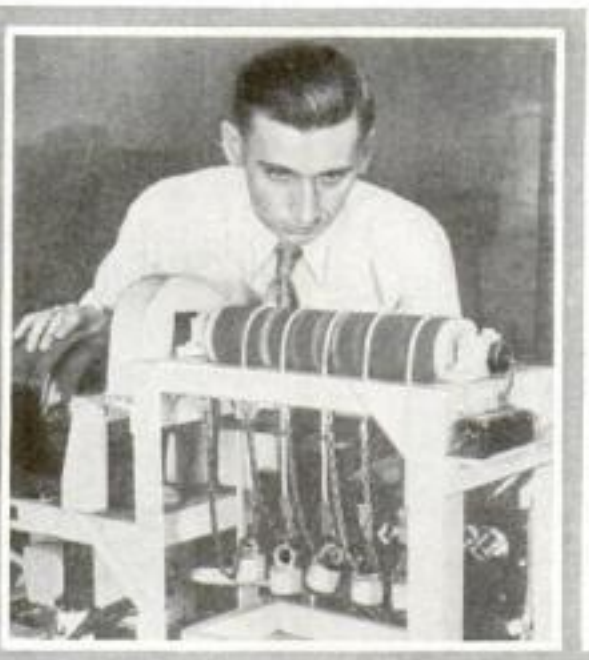
Electrical Equipment Subjected to Severe Grueling in Laboratory That Searches for Defects in Materials

IF YOUR electric iron short-circuits or the bottom of your cookpot burns through, you may have just cause for complaint. To guard against such occurrences, some of the country's largest makers of electrical equipment coöperate in maintaining, in New York City, a unique research organization known as the Electrical Testing Laboratories. Here a mechanical third-degree is applied to all types of electric accessories. Through the odd tests pictured on these pages, manufacturers learn what material for electric cords is most resistant to fraying and how to make connection plugs proof against breaking.

WHERE IS YOUR REFRIGERATOR COLDEST? Did you know that the temperature inside your refrigerator varies at different points? By means of resistance thermometers, wired to outside gages, as shown above, the degree of cold at any point in the refrigerator is determined. The tests are conducted in a concrete vault lined with pipes so that any outside temperature is possible during the work



BOUNCING GOLF BALLS. Out of the spout come the golf balls, each striking the floor in front of the machine, right, at the same point and bouncing from there to the center of the small table. Any defect in the ball will keep it from landing in the center. Carbon dots show exactly where the ball struck. Note how close the dots are to each other



ELECTRIC CORD TESTED The apparatus, above, consists of a rotating cylinder covered with emery cloth. Electric cords, one end attached to terminals on the machine and the other bearing small weights, are thrown over the cylinder. The amount of use that will wear through the insulation is thus found

WEARING OUT ROASTERS A stream of sand falls continuously on the bottom of a cooking utensil, right, to test the wearing quality of the material

DON'T OPEN OVEN DOOR. When you open the oven, you let out most of the heat. The electrical thermometers, under test here, record the temperature of the oven and even of the cooking meat without once opening the door

by Third Degree Tests

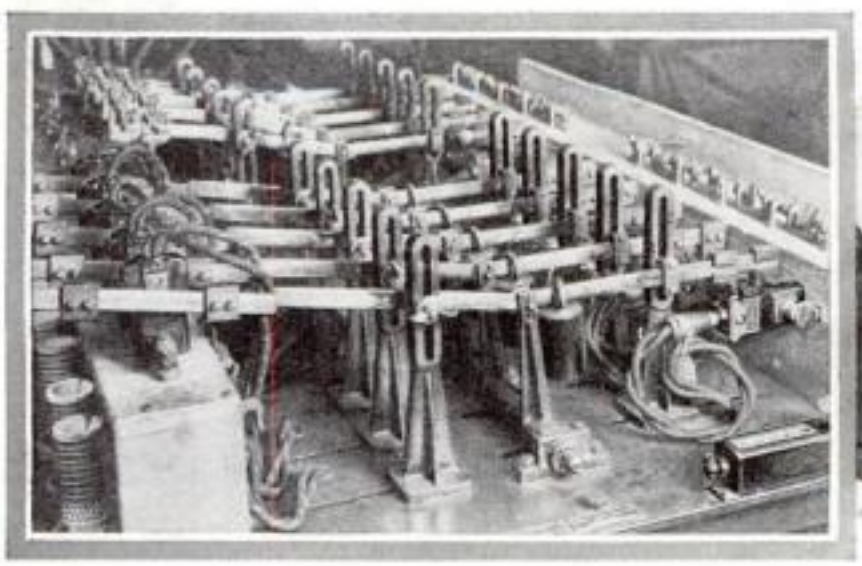
HOW BRIGHT IS YOUR ELECTRIC BULB? The large sphere shown at left is intensely white on the inside. Electric bulbs are placed in it and, as the door closes, connection is made. Through a small window, light escapes and falls upon a photo-electric cell which in turn operates a meter. The strength of the light is thus gaged in comparison with standard bulbs

ANOTHER CORD TEST. Both plug and cord are tested in this machine. It imitates the strain on cord when you pull out the plug

CURRENT TESTS GLOVES. Rubber gloves are held by clips and then lowered into a tank of water as at right. A heavy electrical voltage is sent through the water. If the gloves leak, a blue haze forms in the water around them and the poor glove is rejected

GOOD IRONING CORDS. In the machine, left, ironing cords are twisted until worn to danger point. The poorer cords stand only 200 turns but the best endure 200,000 revolutions before tearing

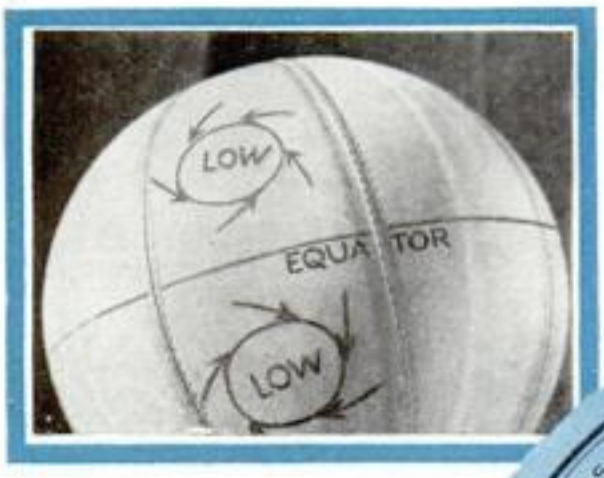
ENDURANCE TEST FOR SWITCHES. Switches, like those you use in your home, are attached to the machine, below, which automatically turns them on and off 120 times a minute. The test shows a vast difference between the poorest switches and the best



DROPPING THE PLUGS The drum-like machine at left, carries an ordinary household plug to the top and drops it. Then it picks it up and drops it again. In this way the number of falls a plug will stand is determined. Some break at once and others can be dropped more than 300 times

INCH-LONG SHIP MODELS
WITH YARN FOR SMOKE
show

How Navigators Escape Hurricanes



Arrows show hurricanes rotate to the left north of the equator and in the opposite way south of it

BEFORE Columbus sailed boldly westward, confident of reaching China in a few days, and bumped unexpectedly into a new continent, the particular perils of the western Atlantic were unknown. It was called "The Sea of Darkness," because no one had met its dangers.

But the voyagers and map-makers of 1492 had good imaginations, and their fancy peopled this Sea of Darkness with monsters that could smash entire ships at a single crunch of their jaws.

These destructive creatures did not, of course, exist in the flesh-and-blood forms in which the early map-makers pictured them but they did have a real and terrible existence in the dreaded West Indian tropical hurricane!

No monster could have wrecked ships more thoroughly than they. Columbus himself had a narrow escape from a tropical hurricane in 1492, and may have contributed his observations on this type of storm to the fund of information navigators have been collecting about it ever since that historic voyage.

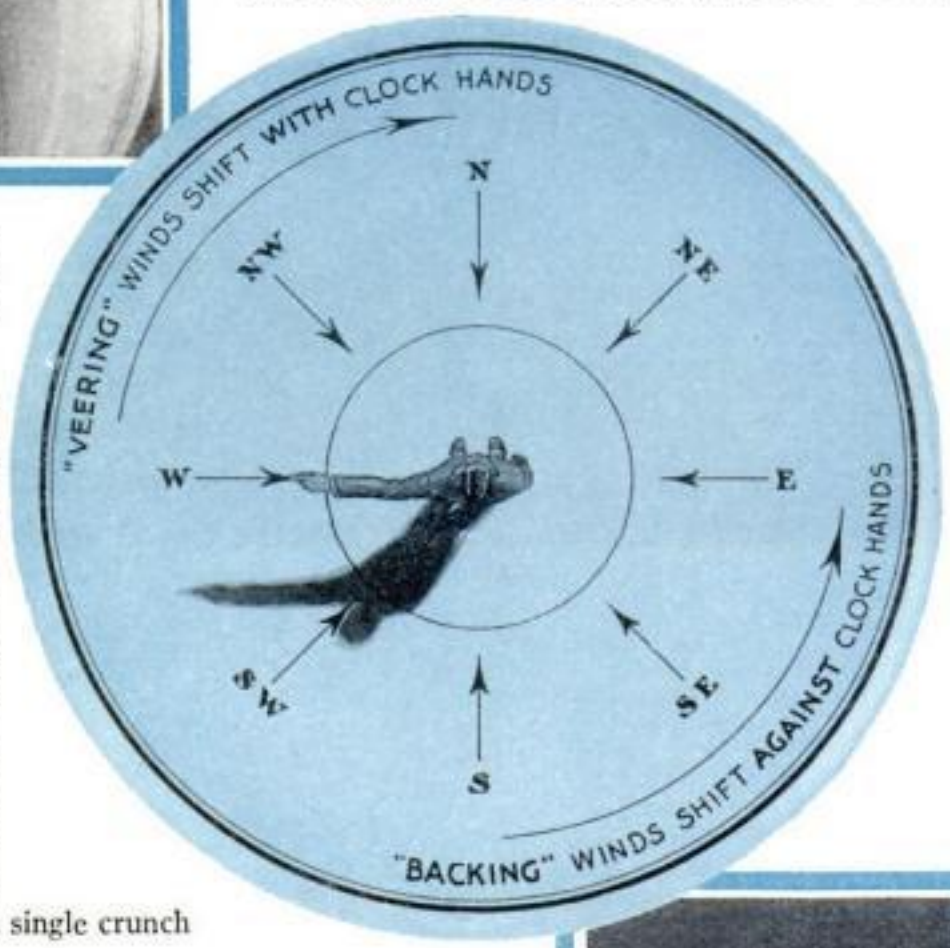
Gradually, through bitter experience, skippers learned something about the shape and habits of the hurricanes that so frequently occur in the Caribbean Sea.

They found that the storm was of circular form and that the winds blew into it from every point of the compass. They discovered that these winds spiral in from all sides toward the center, becoming more and more violent until the middle is reached. But at the center they found a comparatively calm circle, sometimes only twenty miles or so across, and often with a patch of blue sky over it! This center was called "the eye of the storm."

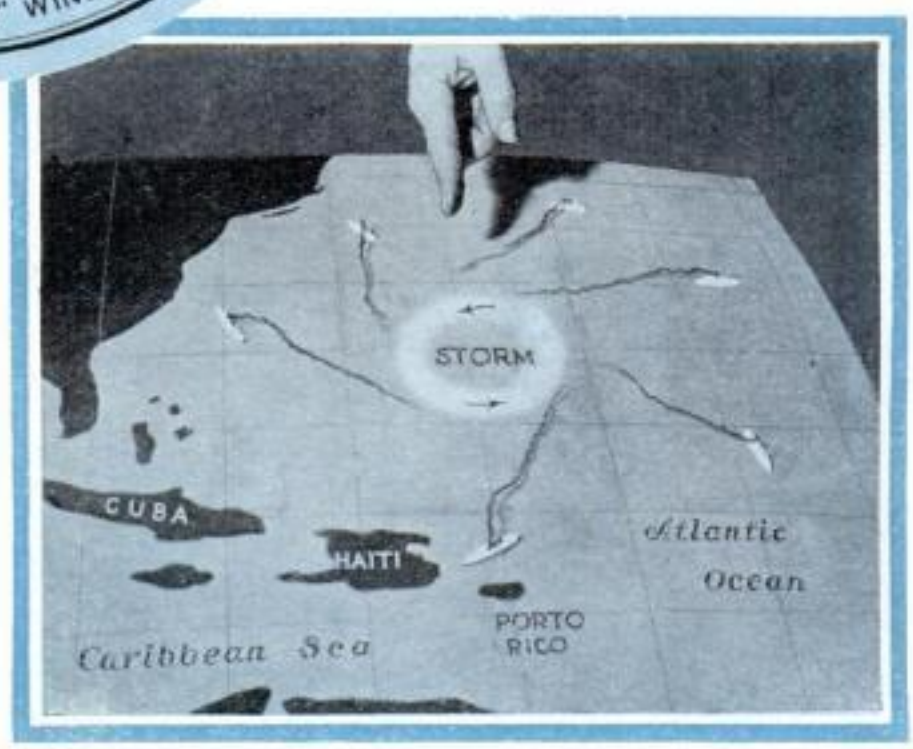
Also, the navigators eventually noticed another peculiarity of the hurricane, which proved to be the most important of all: *in the Northern Hemisphere the storm always rotates from right to left, in the contrary direction to a clock's hands.* In the Southern Hemisphere, they whirl the opposite way, that is in a clockwise direction.

This was such a remarkably regular habit that thoughtful ship captains seized upon it as the one thing that could be predicted about their behavior. It seemed to them that the *invariable counterclockwise* whirling of a West Indian hurricane might be made the basis of some rules by which a skipper could get out of a storm's path.

This proved to be true, but the rules did not become uniformly reliable until another important fact was noticed by a Dutch scientist named Buys-Ballot. His discovery was this: He found that if a sea captain stood on the deck of his steamer *with his back to the wind* (with the smoke of the funnel streaming straight away in front of him), *the*



With the aid of this diagram you can locate the center of a thunder storm by noting the direction in which the wind shifts. With your back to the wind, your extended left arm will point in the direction of the approaching storm



You can see on the picture at right, how the smoke trails from the six steamers in the neighborhood of a West Indian hurricane spiral into the storm and indicate the direction of wind around it

By

GAYLORD JOHNSON

Captains Can Now Dodge Sea Storms Through Knowledge of a Scientific Law That Has Ended Guesswork by Sailors

•

center of any near-by storm or low pressure area was always on his left hand.

Buys-Ballot's discovery gave seamen a clear understanding of the behavior of West Indian hurricanes and the East Indian typhoons. Still more important, it showed them the way to maneuver their ships out of the path of any storm that might approach them.

To make Buys-Ballot's law, and its application to a ship clear, I made a map of the Caribbean Sea and several tiny models of steamers. To the funnel of each ship, I glued a strand of black knitting yarn, representing smoke. This black strand could be laid out on the map to indicate the wind direction at the ship's location.

The smoke-trails of the six little steamers on the map show how the winds at all points surrounding the low pressure area blow *toward* the storm and *spiral into it* in the "counterclockwise" direction.

You will find it interesting to verify Buys-Ballot's law for yourself. Try it on the very first rainstorm that comes along. When the wind shifts in the same direction that the hands of a watch move, it is said to veer. When it shifts in the opposite direction (counterclockwise) it is said to back. Now you are ready to test Buys-Ballot's law with a thunderstorm.

Suppose it is a hot day, and the wind springs up from the south. If you have an aneroid barometer you look at it and find that it has begun to fall. A thunderstorm is somewhere in the vicinity. In which direction is it? Buys-Ballot's law will tell you.

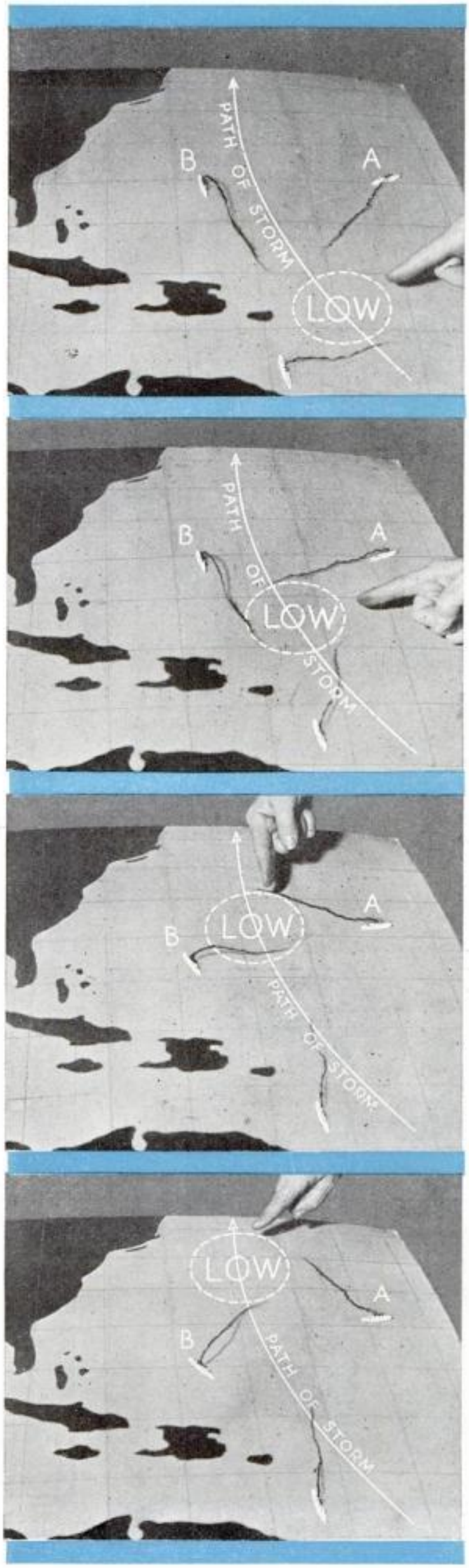
Stand with your back to the south wind and extend your left arm. It points to the west and indicates the direction of the thunderstorm.

Now suppose that the south wind veers into the southwest, then into the west, and finally into the northwest. Where is the storm while the wind is shifting through these points of the compass?

If you stand with your back to the wind while it is shifting and keep your left arm extended, Buys-Ballot's law tells you the position of the storm center.

When the wind was south the storm was to the west; when the wind veered southwest, the low pressure was northwest of you; when the wind became west, the storm was northward; and when it finally blew from the northwest, the thunderstorm was to the northeast of you. In other words, the depression passed by to the north of your location.

If you live south of the equator, you need only extend your right arm instead of your left in verifying Buys-Ballot's law.



1

The captain of ship A notices that his barometer is falling. The direction of the wind is northeast, carrying his smoke southwest. When he puts his back to the wind he knows that the storm center is to his left. He decides to stop the ship and wait to see which way the storm is going. The captain of ship B reaches the same decision and he will wait

2

After waiting a short time, the skipper of ship A notices that the wind has shifted toward the east. When he puts his back to it, he knows the storm center is traveling north. It may be that he will run into it if he proceeds, for the barometer is still falling. He will heave-to and wait a little longer. The captain of ship B sees that the wind has not changed but is getting stronger and his barometer is falling rapidly. The storm is coming toward him from the south. He must change his course to avoid it. Which way? As he knows the low's center is to his left, he turns his ship to the right

3

After another short wait, the captain of ship A sees that the wind becomes easterly and then southeasterly. At the same time his barometer stops falling and soon starts to rise. Then he knows the hurricane is passing in front of him on a northward path. The captain of ship B also knows from the change in his smoke's direction and his rising barometer, that the depression is passing to the eastward of his position. He is free to resume his course

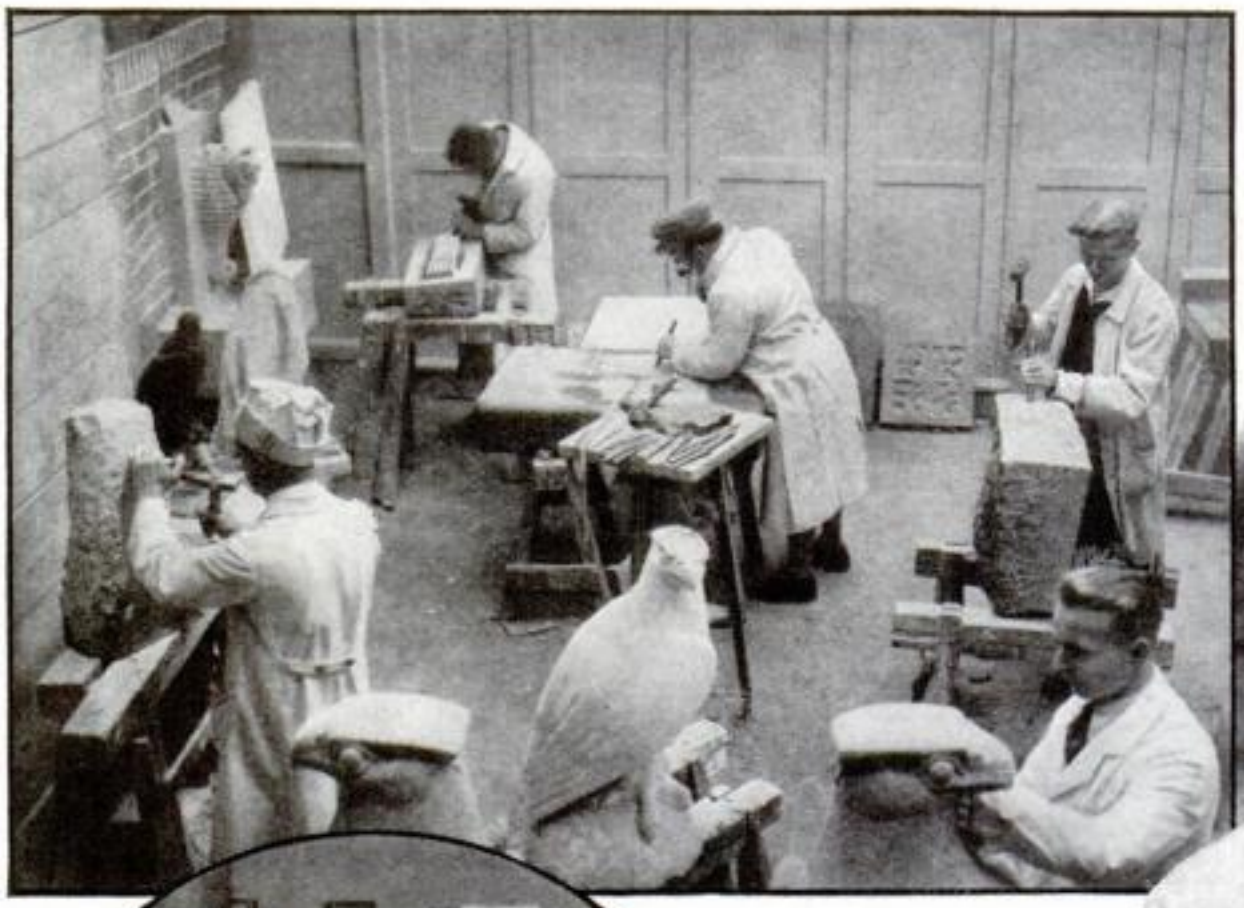
4

Similarly, the captain of ship A knows that he can continue on his course as the wind is now southeast, showing that the storm has passed to the north well in front of him

Simple Law Helps Captains Avoid Storm

How Sculptors Put Life in Granite

Secret Tricks of the Art Taught in Unusual School that Uses the Outdoors as a Classroom for Students

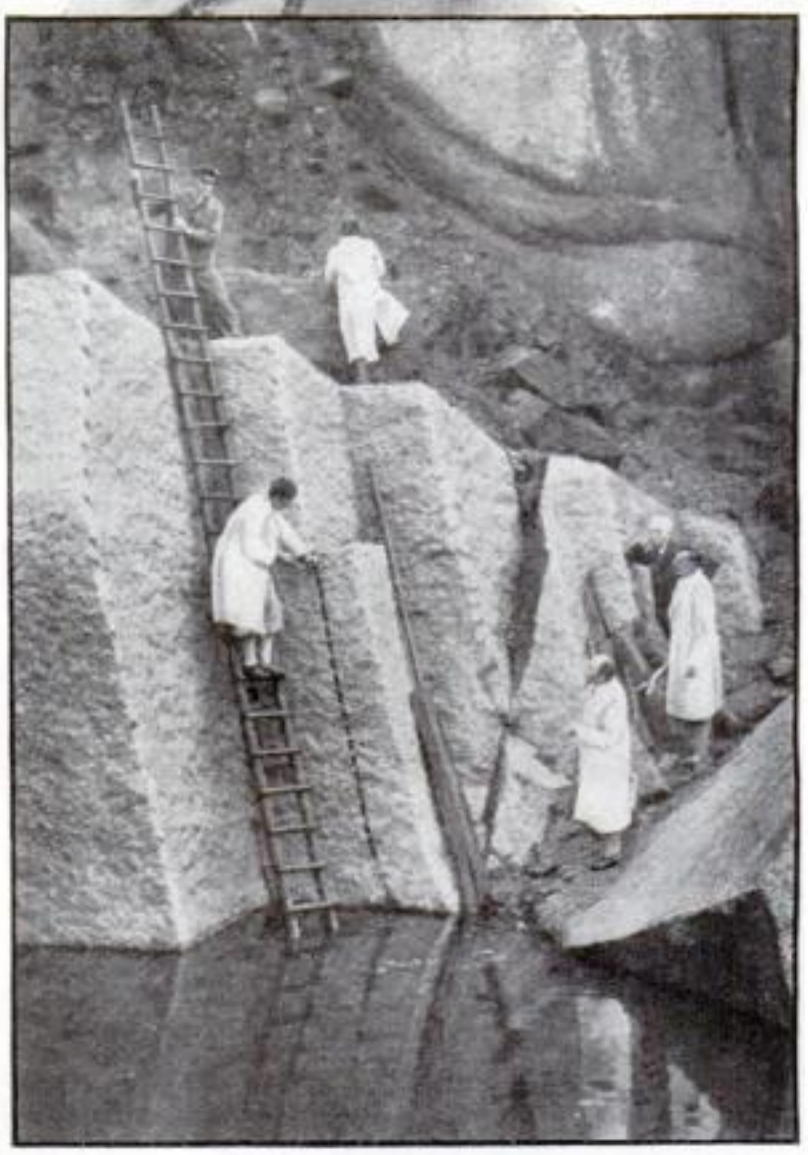


MODERN TOOLS AID SCULPTORS.

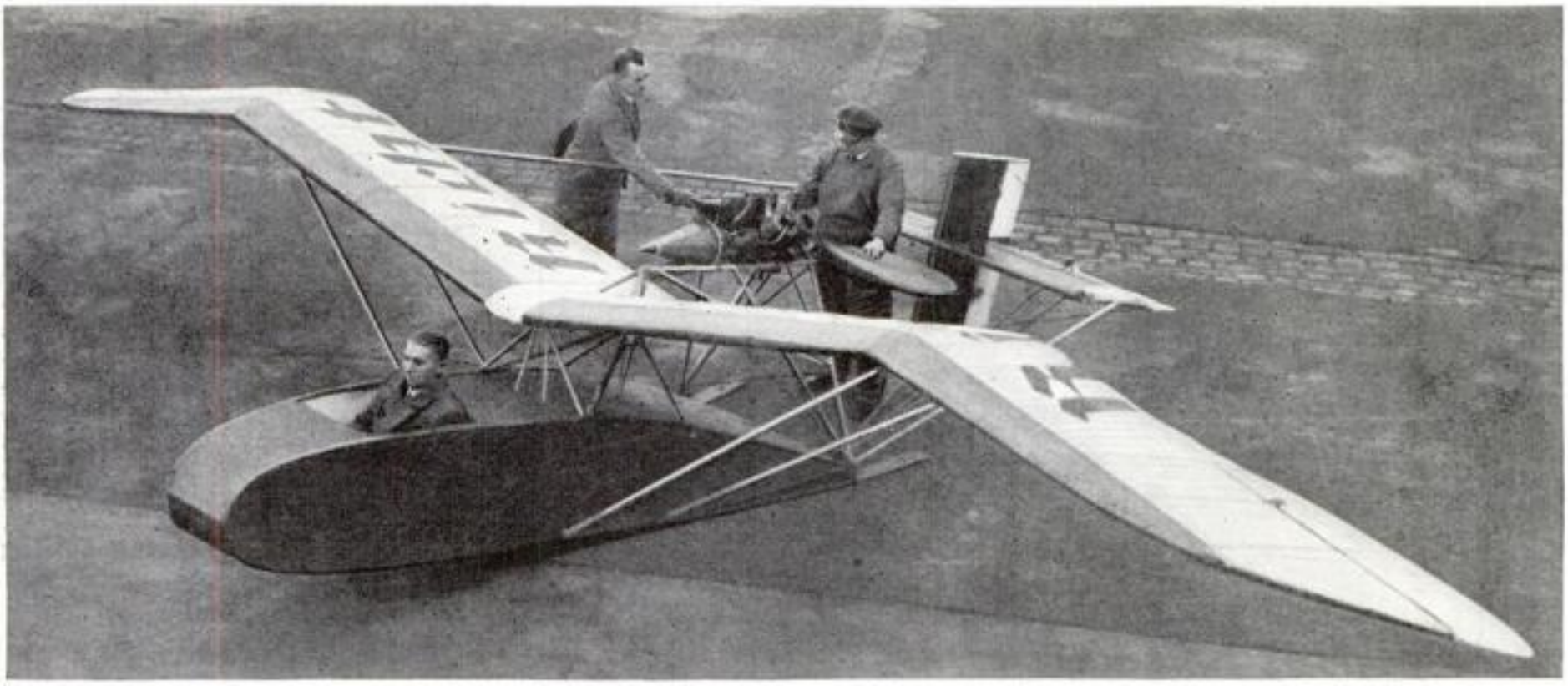
In shaping the hard granite to the living form, the sculptor is taught to use an electric chisel. With this and other power driven tools he can rapidly create in stone a copy of the model. Above, students at work with hammer and chisel doing the things for which the electric powered tool is thought unsuited

HOW GRANITE IS CARVED.

Sculptors who work in granite attend this school at Wunsiedel in Germany where there are large quantities of the material ready for their use. The pictures on this page show the activities of this strange school. At right, the head master is demonstrating the fine points of granite carving. In circle, students are making a clay model before attempting a reproduction of it in rock



Fine granite is plentiful at Wunsiedel and the young sculptors select their own material. Out of the block here being measured, one of them will carve a bust of Hindenburg



Bird-Like Plane, with Zigzag Wings, Meets First Tests

FIRST trials of a curious bird-like airplane, recently held at a Berlin airport, were reported a success. The unconventional machine was designed by Hans Richter, noted German aviator, to test the aerodynamic qualities of wings of zigzag contour in comparison with the usual straight design. A motor no larger than a motorcycle engine, fed with gasoline from a small streamlined tank and driving a pusher propeller, suffices to fly the featherweight craft.

A blackboard, built into this child's desk, hangs at the back when not in use but is easily swung into position at the front. It can be detached

DESK FOR CHILD HAS BUILT-IN BLACKBOARD

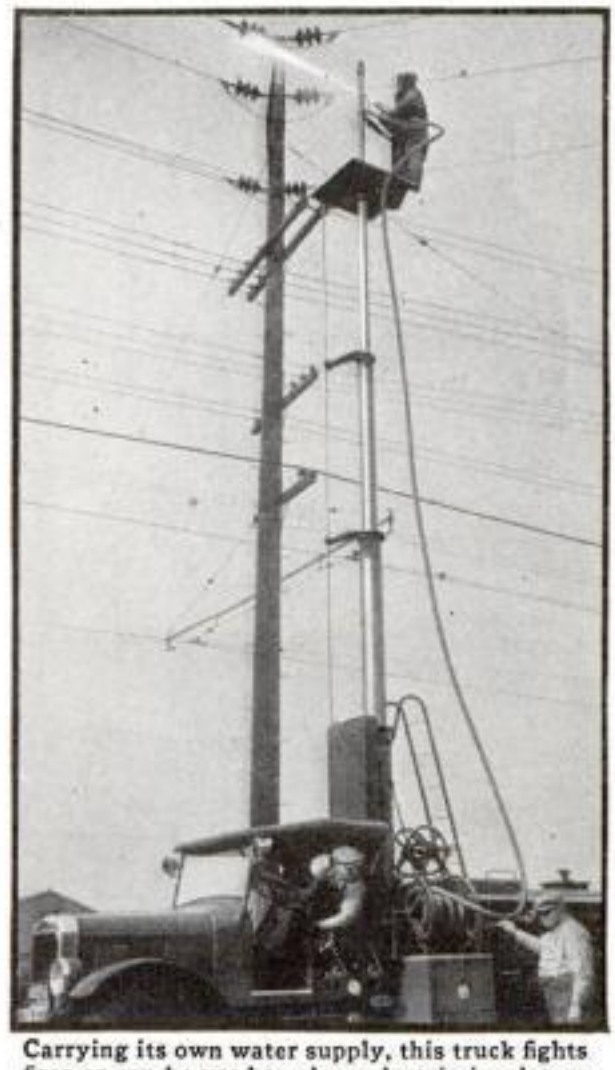
A CHILD'S desk with a built-in blackboard provides entertainment and instruction. The blackboard hangs behind the desk when not in use, but is readily swung into position at the front. If desired, it may be detached and used separately. The desk itself is of roll-top construction and is made of oak.

PENCIL IS ALL "LEAD"

ALL "lead" and devoid of a wooden casing is a new pencil that has appeared on the market. The stick of solid graphite may be given any desired type of point, or may be brought to a fine tip in a sharpener.

WATER SUPPLY CARRIED BY CITY FIRE TRUCK

CARRYING its own water and chemical supply a fire truck extinguishes brush fires and blazes caused by short-circuits on electric poles for the city of Los Angeles, Calif. Power from the truck's own engine raises a telescoping tower to a height of thirty feet, to give the firemen an elevated point of vantage. When not employed in fighting fires, the truck is used for the periodic cleaning of insulators, as shown in the photo below, and is driven with the tower raised.



Carrying its own water supply, this truck fights fires or can be used to clean electric insulators

TIED DOWN HOUSE IS HURRICANE PROOF

EVEN the force of a hurricane will not unroof the house of one Florida home owner, or sweep it from its foundations, for the house is tied down. After witnessing the disastrous experiences of some of his neighbors in wind storms, this man passed steel cables over his roof and anchored their ends securely in the ground. Turnbuckles provided a means of taking up the slack in the cables and making them taut. The photograph above shows the owner putting the finishing touches to his installation.

Russian Ship Fights Way Through Ice of Northeast Passage

This Russian ship, with propellers broken, fought its way through the Northeast Passage

ARCTIC history was made the other day when the Russian icebreaker, *Sibiriakov III*, came into port at Yokohama, Japan, after a 3,000-mile dash from Archangel, Russia, through north polar regions and around the eastern tip of Siberia. It was the first time a ship had navigated the frigid Northeast Passage without spending the winter locked in the ice. For the crew of sixty-five, including three women and a staff of scientists, the three-month trip in search of a new commercial trade route was filled with hazard. Before the ship escaped from the Arctic, both its propellers were broken and sails had to be rigged. The disabled craft crawled through by hauling itself along with a rope tied to an ice crag.

With a cable anchored to ice crags and a winch aboard ship, the vessel inched itself through ice

VANES ON WINDMILL REGULATE ITS SPEED

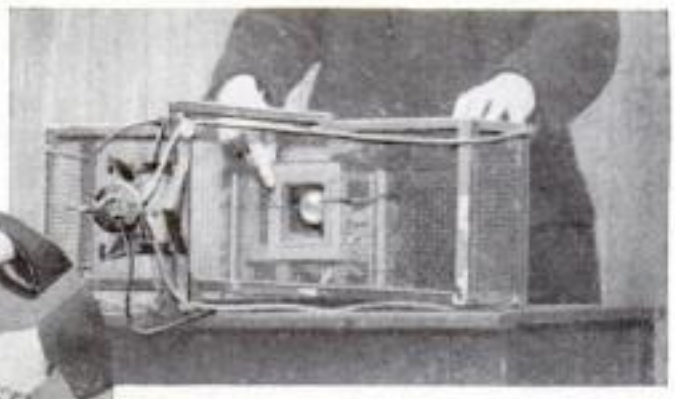
A WINDMILL that is said to run at constant speed, regardless of the velocity of the wind, has been patented by an Auburn, Ind., inventor. A pair of side vanes, spreading or closing under the variable force of the wind, automatically controls the speed of the windmill much as a governor regulates a steam engine. As a result of its unvarying speed, the windmill may be used to run an electric generator.

Vanes that open and close with the force of the wind are designed to keep this windmill, recently invented, running at regular speed

LIGHT LURES FISH INTO TRAP

LURING fish with colored lights is the speciality of Herbert W. Spear, of Portland, Maine, who, before interested U. S. Bureau of Fisheries officials, recently demonstrated some of the luminous fish-catching devices he has invented. A small model of a folding fish trap, containing batteries and an underwater light, was let down into the water and was soon filled with fish. Spear plans a lure with light that changes color.

Containing an underwater light, this fish trap readily lured fish into it. The cluster of hooks, right, surrounds such a light

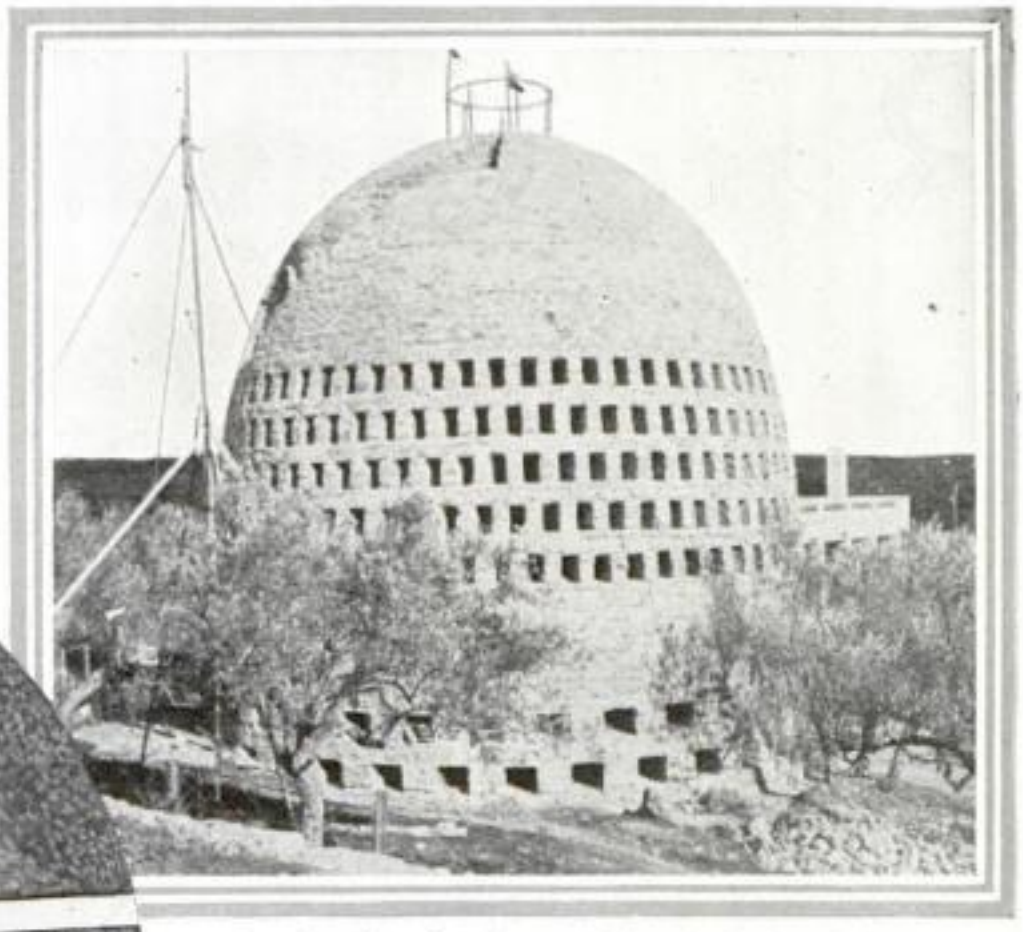


This is the form of trap, containing a light, that is used to catch fish. The inventor is working on a system of changing the color of the light to attract the fish

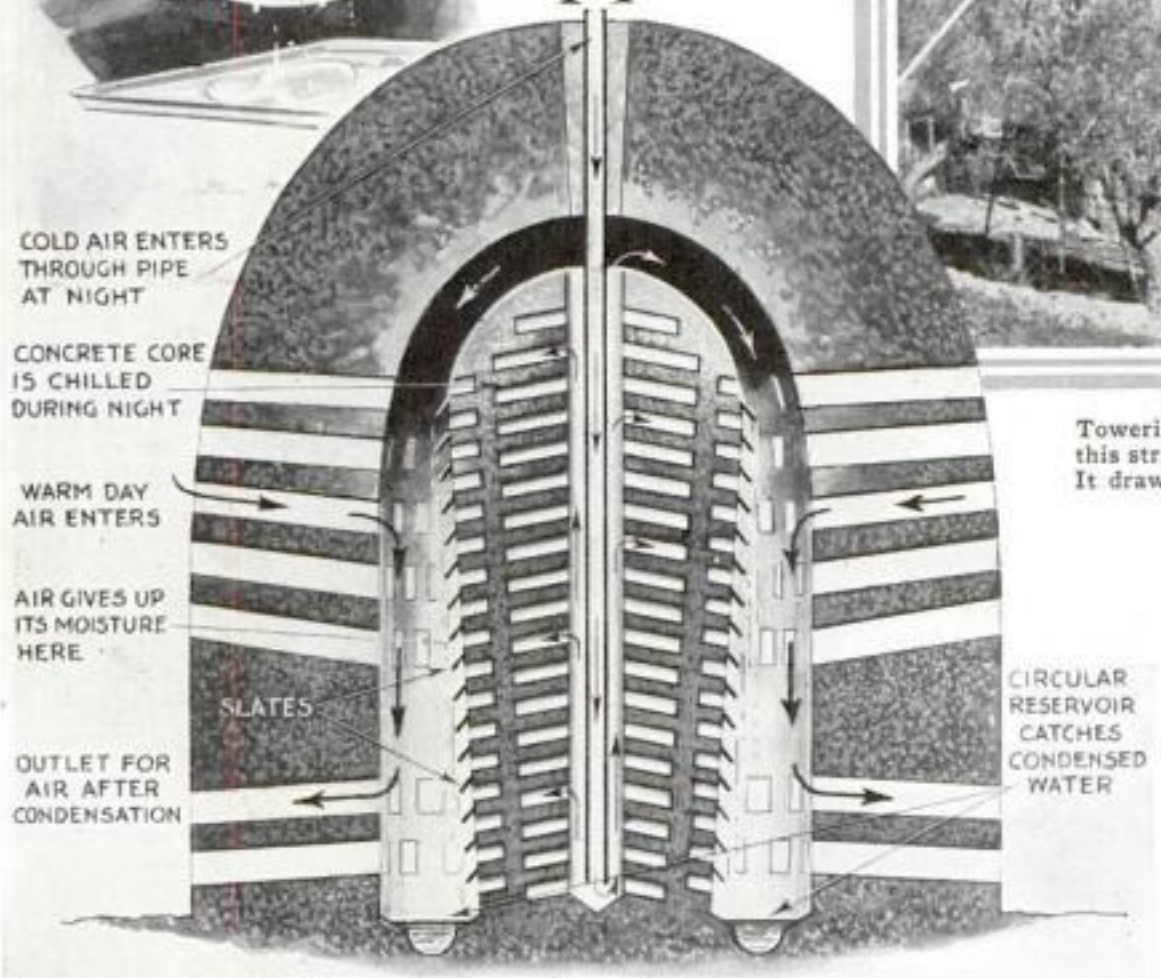
Air Well Waters Parched Farms

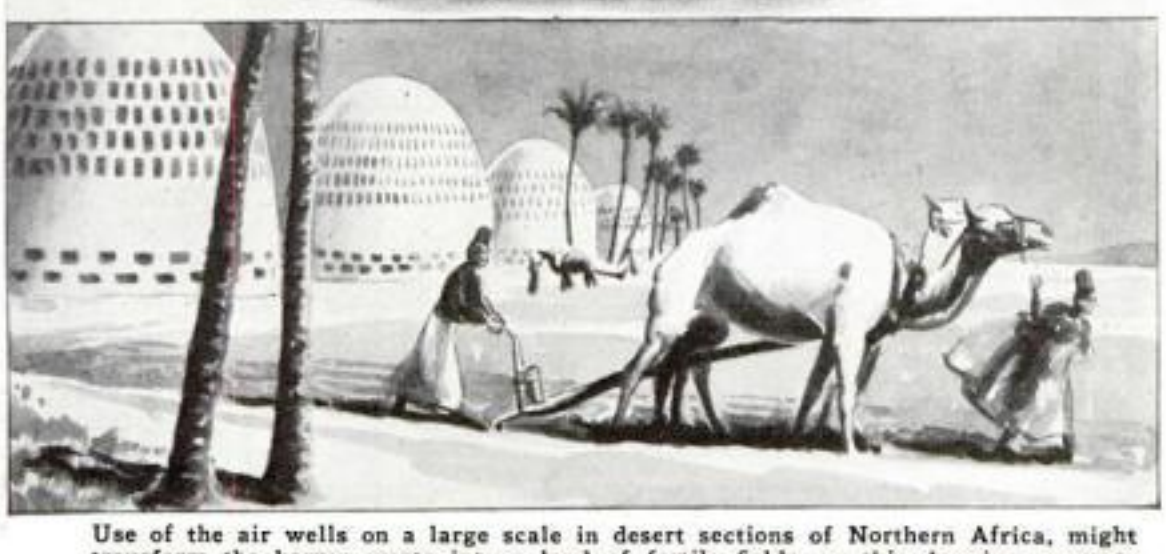
Beehive Structure on Hill Draws Moisture from Atmosphere and Holds It in Reservoir

On the outside of a pitcher filled with ice water, drops of dew gather, condensed out of the air by the cold. This is the principle of the air well explained in the drawing below



Towering forty feet above a hilltop in Southern France, this strange air well is not unlike a beehive in appearance. It draws water from the air and stores it in a reservoir





Use of the air wells on a large scale in desert sections of Northern Africa, might transform the barren waste into a land of fertile fields, as this drawing suggests

EXTRACTING water from the air to irrigate fields and vineyards is an accomplished feat in southern France, where first tests of an amazing invention called an aerial well have just met with complete success.

Towering forty feet above a hilltop overlooking the little town of Trans-en-Provence, this remarkable structure resembles nothing more than a monster beehive. Its grayish-white walls of stone are perforated with scores of openings. Warm outdoor air entering through these ducts is systematically robbed of its moisture by contact with the chilly interior, much as dew condenses on a pitcher of ice water.

While the present well is an experimental one, the inventor, M. A. Knapen, foresees that practical application of the idea will transform parched regions, like the arid lands of north Africa, into blossoming fields. Droughts that have killed great herds of livestock in these areas would be things of the past.

Taking water from the air instead of the earth is not a new idea. Archaeologists have discovered that the ancient city of Theodosia, situated in one of the dryest sections of Crimea, was abundantly supplied with water 2,300 years ago by a similar plan. Thirteen great heaps of broken limestone were loosely piled on a nearby hilltop. Moisture condensing from the air within these piles was led by ducts to the fountains of the city, and there is no record that they ever ran dry.

The aerial well of Trans is a modern, scientific application of the same idea. It comprises a dome-like, perforated shell of stone and mortar, with a thickness of eight to ten feet to prevent the penetration of the sun's heat; a mushroom-like inner core of concrete, pierced with numerous ducts for the circulation of air; and a central pipe with its upper opening above the top of the outer dome.

At night, cold air pours down the central pipe and circulates through the core as shown in the diagram. By morning the whole inner mass is so thoroughly chilled that it will maintain its reduced temperature for a good part of the day. The well is now ready to function.

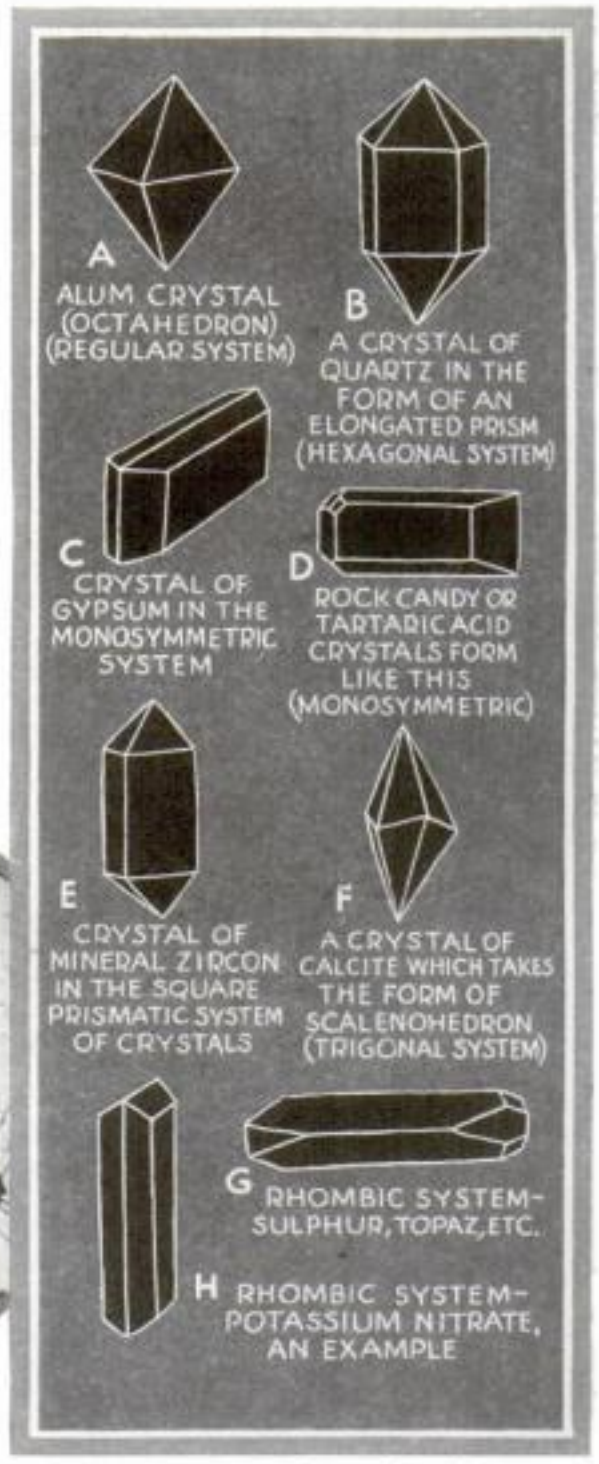
Warm, moist outdoor air enters the central chamber, as the daytime temperature rises, through the upper ducts in the outer wall. It immediately strikes the chilled core, which is studded with rows of slates to increase the cooling surface. The air, chilled by the contact, gives up its moisture upon the slates. As it cools, it gets heavier and descends, finally leaving the chamber by way of the lower ducts. Meanwhile the moisture trickles from the slates and falls into a collecting basin at the bottom of the well. By this principle, the inventor believes it possible to obtain as much as 6,000 gallons of water daily for every 1,000 square feet of condensing surface.

Trailing Rare Crystals WITH A MICROSCOPE

For most crystal formations, it is advisable to swing a lower powered objective into position as is being done in the photo above. This gives a wider view

The strange geometrical figures at right are the crystals of potassium sulphate as seen under a microscope. The crystals are more beautiful than the photo shows because they break up the light and are gay with color

The paving stone figure at left is really a crystal of common salt and it is not flat but is almost a perfect cube, slightly distorted by the surface it grew on



In this diagram are shown a few of the many forms taken by crystals of different substances, each of which clings to its own type

BEAUTY of form and color reigns supreme in the strange world of crystals. Into this exciting laboratory of nature, where mathematical exactitude is the law, we are now ready to enter. Here we shall find geometry blended with art—a combination making a powerful appeal to the scientific and the esthetic. And the key to this marvelous world of crystals is the lens of your microscope.

The instrument we use need not be elaborate. One that multiplies fifty times will meet our needs. In the examination of most crystal forms, high power is a disadvantage as many of the formations we desire to see are fairly large. It should be borne constantly in mind that the higher the power of the lens used the smaller the area covered. The really high powered microscopes thus afford us a peep at only a few thousandths of an inch at a time of the specimen under the lens.

In stirring a spoonful of sugar in coffee or sprinkling a bit of salt in consommé, we are unwittingly destroying millions of tiny, sparkling gems. Nature has divided most solid matter into two principal forms—the crystalline and the amorphous. Graphite and talc are members of the amorphous category. The crystalline, so beautifully represented by common table salt, is distinguished by the fact that its molecules, when they are normally associated, take certain definite positions that result in the formation of many types of crystals, some of them cubes, others oblong, hexagonal, or octagonal. Crystalline matter is really made up of countless millions of smaller crystals, all in perfect geometrical relationship to each other.

First, let us prepare a supersaturated solution of table salt. By supersaturated we mean that the hot water has dissolved salt until it cannot take in another bit. A microscope slide is wiped clean and a few drops of the supersaturated solution of table salt are placed upon it. This is then set aside for a few minutes to dry. When we return to it we shall find that the water has evaporated leaving a few tiny crystals.

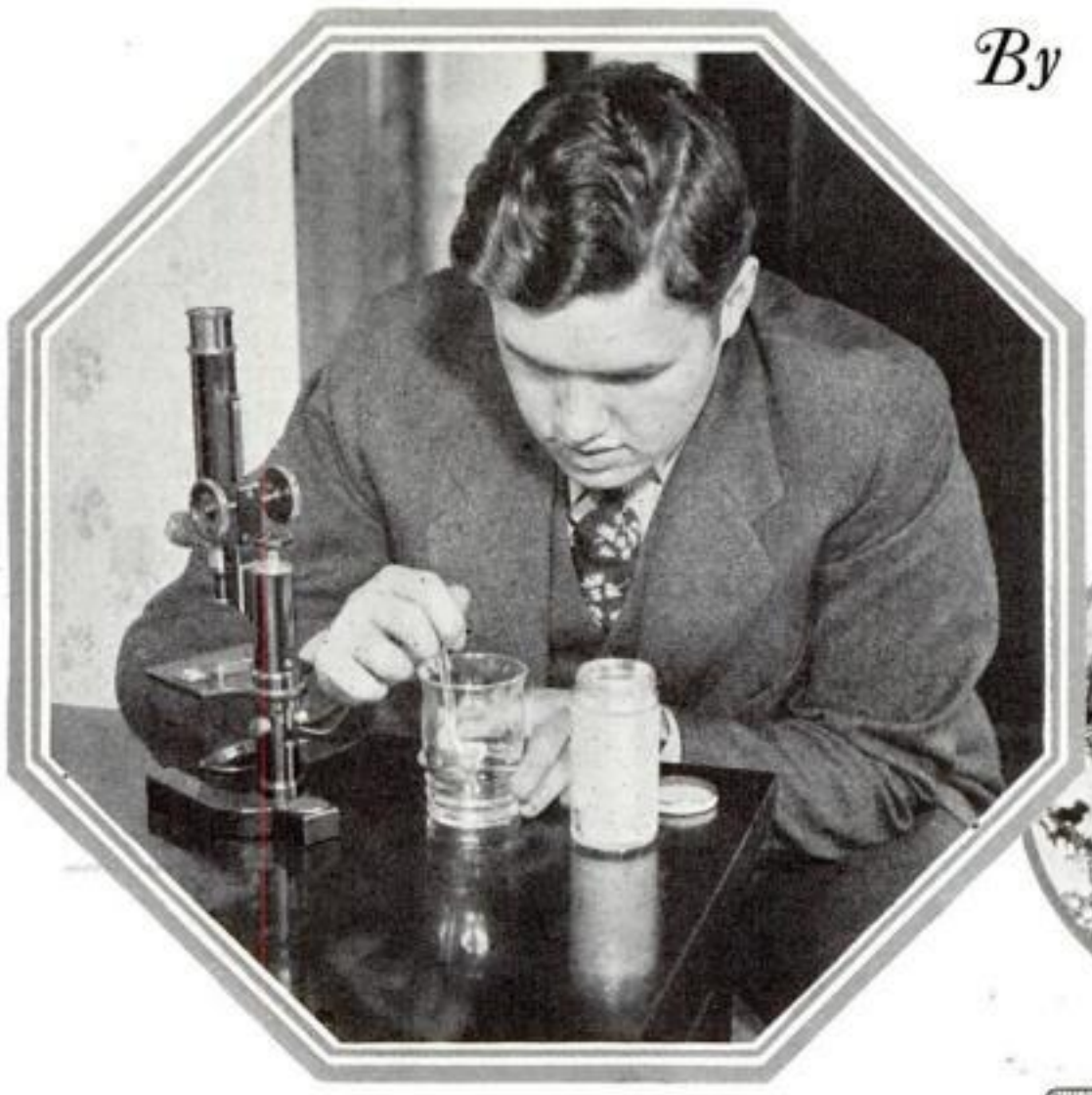
The slide is placed on the stage of the microscope, under the two little clips, so that the salt crystals will be directly over the hole in the stage. The light is turned on and the mirror under the stage adjusted until a soft glow is produced. Now the objective is brought close to the surface of the crystals and the instrument focused upward until we see a number of little cubical gems, the box-like crystals of table salt. They have lost their perfect cubical form because a certain amount of distortion is caused by the solid articles with which they were in contact while forming.

All crystalline substances are classified, physically at least, according to the geometrical forms assumed. Alum takes the form of an octahedron. Those not acquainted with an octahedron are referred to Figure A in the drawing on this page. Figure B shows the shape taken by the crystal of quartz. These crystals are members of what has become known among the students of such things, as the Regular System and the Hexagonal System.

In our microscopic examination of crystal forms, we shall find that some crystals are much larger than others. We may be surprised to know that crystal may be grown from seeds to very large sizes, so large, indeed, that we need no microscope to examine them. Today radio stations are kept on their proper wave lengths by large crystals of Rochelle salts. These have the curious property of expanding

By Borden Hall

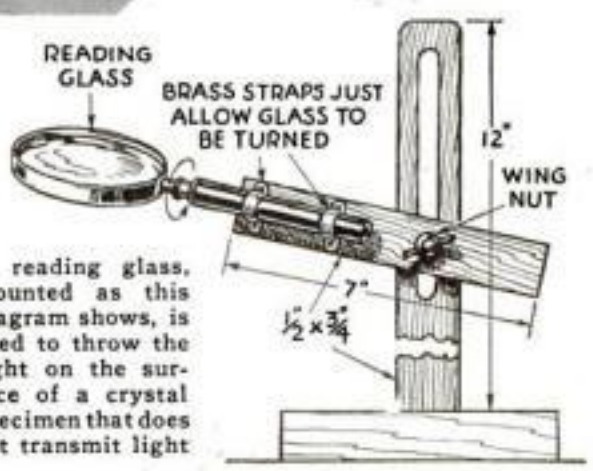
Myriad Forms of Startling Beauty, Originating in the Laboratory of Nature, Are Revealed with Your Lens



Here common household salt is being dissolved in hot water. Afterwards, a few drops will be placed on a slide and left to dry. Then the crystals can be studied

The amazing nest of tiny needles seen at the left was formed when baking soda was dissolved in warm water and then a few drops evaporated. The lens sees them as glittering, sharp pointed and colored jewels

When a bit of coal is magnified 200 times it looks like this and reveals its plant origin



A reading glass, mounted as this diagram shows, is used to throw the light on the surface of a crystal specimen that does not transmit light

and contracting at a definite frequency when excited electro-statically by radio currents. These crystals, so useful commercially, are developed from tiny seed crystals in the laboratory.

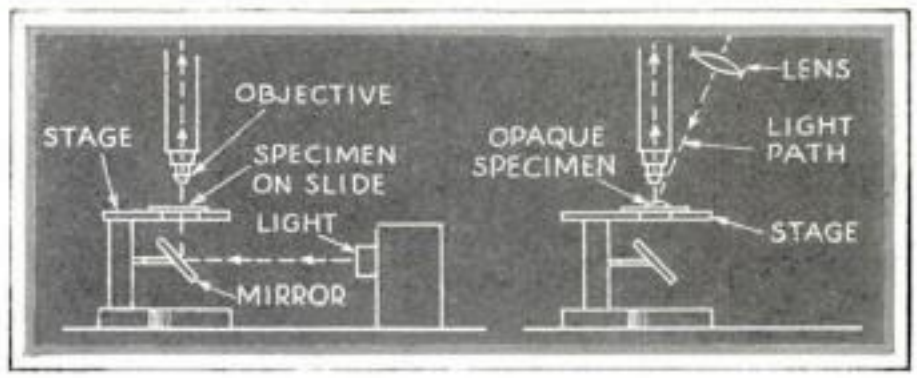
A supersaturated solution of ordinary baking soda is prepared exactly as was the salt solution. Again the slide is adjusted to the stage of the microscope and again we look at the result. Here we see crystals taking a needle-like form. We have left the Regular System. If we can obtain a bit of the mineral calcite (Figure F), we shall enter the Trigonal System. Quartz (Figure B) is a member of the Hexagonal System. Although quartz does not offer a very striking sight under the microscope, its industrial and domestic uses make it a most interesting substance.

Due to the manner in which nature has arranged the tiny bricks in quartz, it will pass ultra-violet light, which is kept out by ordinary glass. Cameras with quartz lenses will take pictures in perfectly dark rooms provided actinic, or ultra-violet, light is present. Windowpanes of these crystals are now used in hospitals and homes so that the full value of sunlight may be enjoyed.

Reference to the outline of crystal forms will acquaint us with the Rhombic System of which sulphur is a member. If a bit of melted sulphur is spread thinly upon a clean glass slide, it will crystallize upon cooling and we shall get a display of golden gems. This little smear of liquid sulphur on the plate, however, must be thin enough to transmit light.

It will probably astonish us to learn that great crystals of copper have been formed and are used to demonstrate properties in the metal that cannot be observed under other conditions. Such crystals have been built up to a weight of several pounds.

Potassium permanganate or potassium nitrate will supply other members of the rhombic system, the potassium permanganate being particularly beautiful under a powerful transmitted light.



Two diagrams above show how light is directed on to a crystal specimen. At right, light on opaque quartz and left, light on transparent object

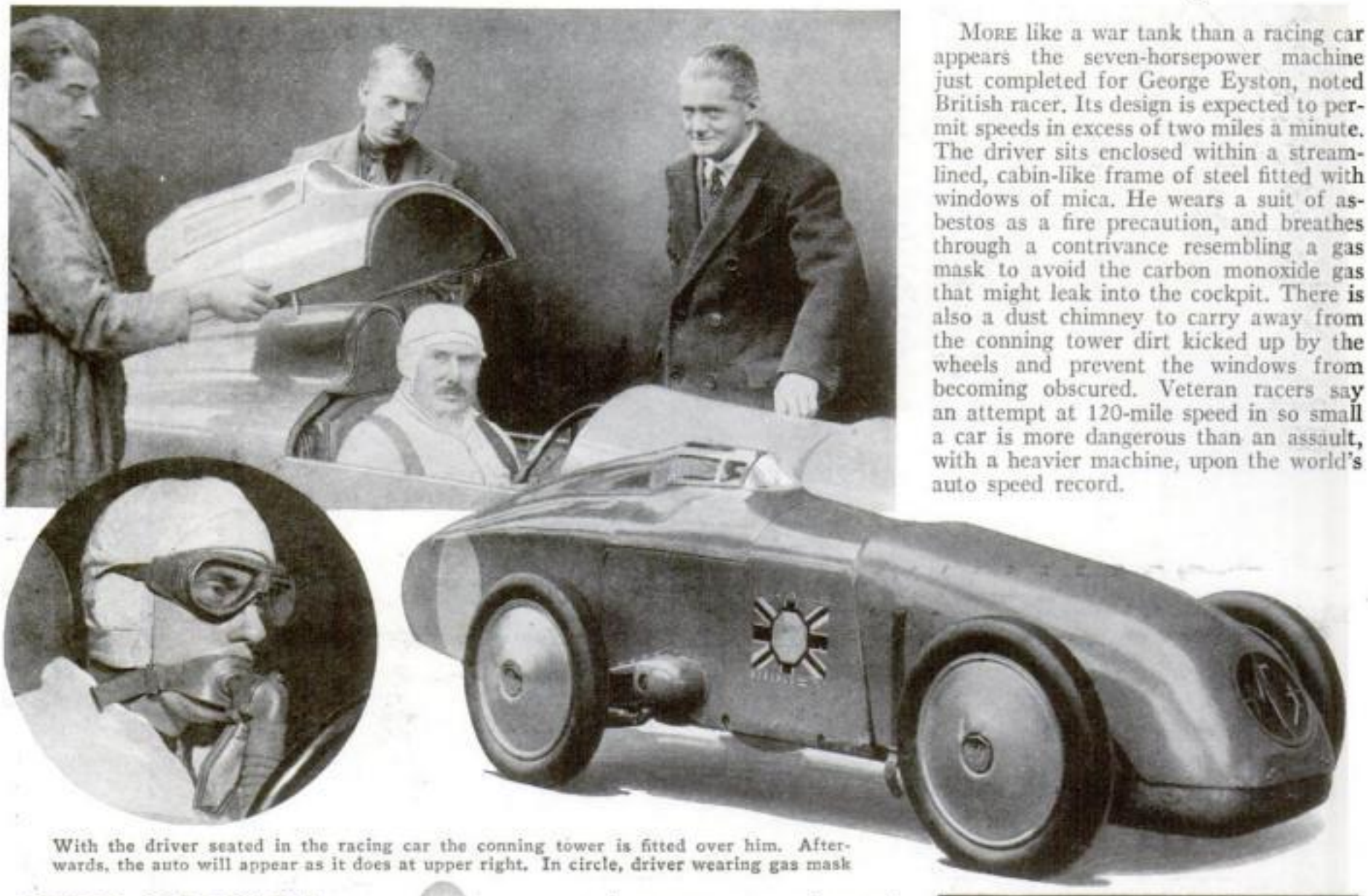
But a far more exciting form of crystallization beckons us. It may be truthfully said that beauty, in its rarer forms, is unknown until we study the crystals of ice. Perhaps we have heard that snowflakes appear in an infinite variety of shapes and designs. Their architecture is one of the great wonders of the world, but we shall have to change our technique if we are going to examine them for here we are dealing with highly perishable objects.

So we must take the microscope and its light source to the garage, the woodshed, or better, right out of doors. If either the garage or the woodshed is chosen, it may be necessary to use artificial light. If so, remember that it cannot be too powerful nor too near the instrument. Otherwise the flakes will melt before we can get them under the lens for observation.

The slides to be used must be chilled to the approximate temperature of the flakes. This is done by placing them in snow and leaving them there for half an hour. Then one of these slides is laid out where the falling flakes will settle on it. Flakes cannot be taken from the ground for there they are inextricably entangled with others and will be broken and destroyed before they can be brought to the stage of the instrument. Experience teaches that a dry, cold snow, without wind, provides the best flakes.

Snowflakes are examined under the microscope in the same manner as any other crystal that (Continued on page 84)

120 Miles an Hour with Seven Horsepower



With the driver seated in the racing car the conning tower is fitted over him. Afterwards, the auto will appear as it does at upper right. In circle, driver wearing gas mask

More like a war tank than a racing car appears the seven-horsepower machine just completed for George Eyston, noted British racer. Its design is expected to permit speeds in excess of two miles a minute. The driver sits enclosed within a streamlined, cabin-like frame of steel fitted with windows of mica. He wears a suit of asbestos as a fire precaution, and breathes through a contrivance resembling a gas mask to avoid the carbon monoxide gas that might leak into the cockpit. There is also a dust chimney to carry away from the conning tower dirt kicked up by the wheels and prevent the windows from becoming obscured. Veteran racers say an attempt at 120-mile speed in so small a car is more dangerous than an assault, with a heavier machine, upon the world's auto speed record.

HIDE CAMERA IN COW'S SKIN

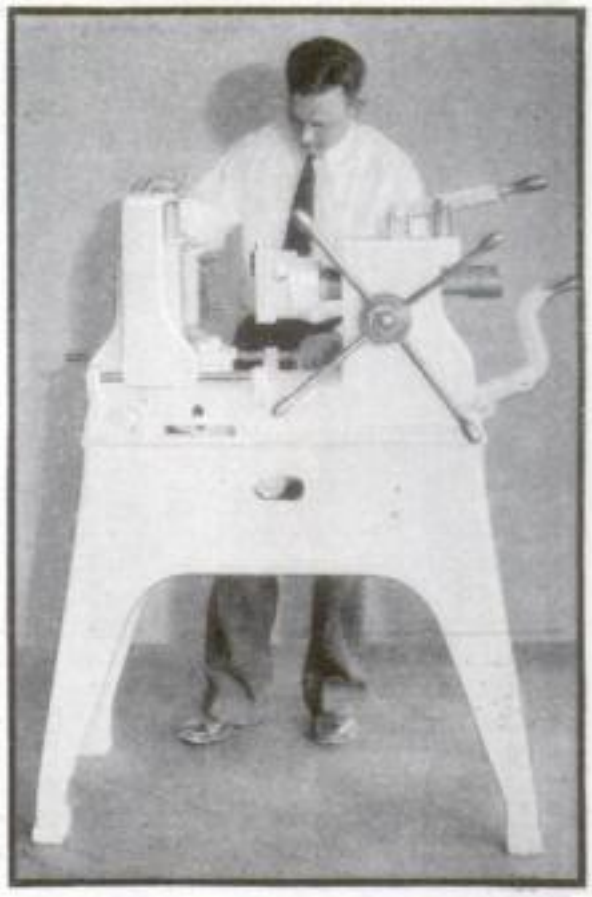
Using as a blind a cow's skin, stretched over wire and padding, cameramen for the California State Game Commission have been able to get rare pictures of animals

Stretched over wires and padding, a cow's skin is now part of the photographic equipment of the California State Fish and Game Commission. The lens of a camera is poked through a hole in the skin, and pictures of wild animals, otherwise unobtainable, are taken.

TOOL PICKS UP DROPPED PARTS

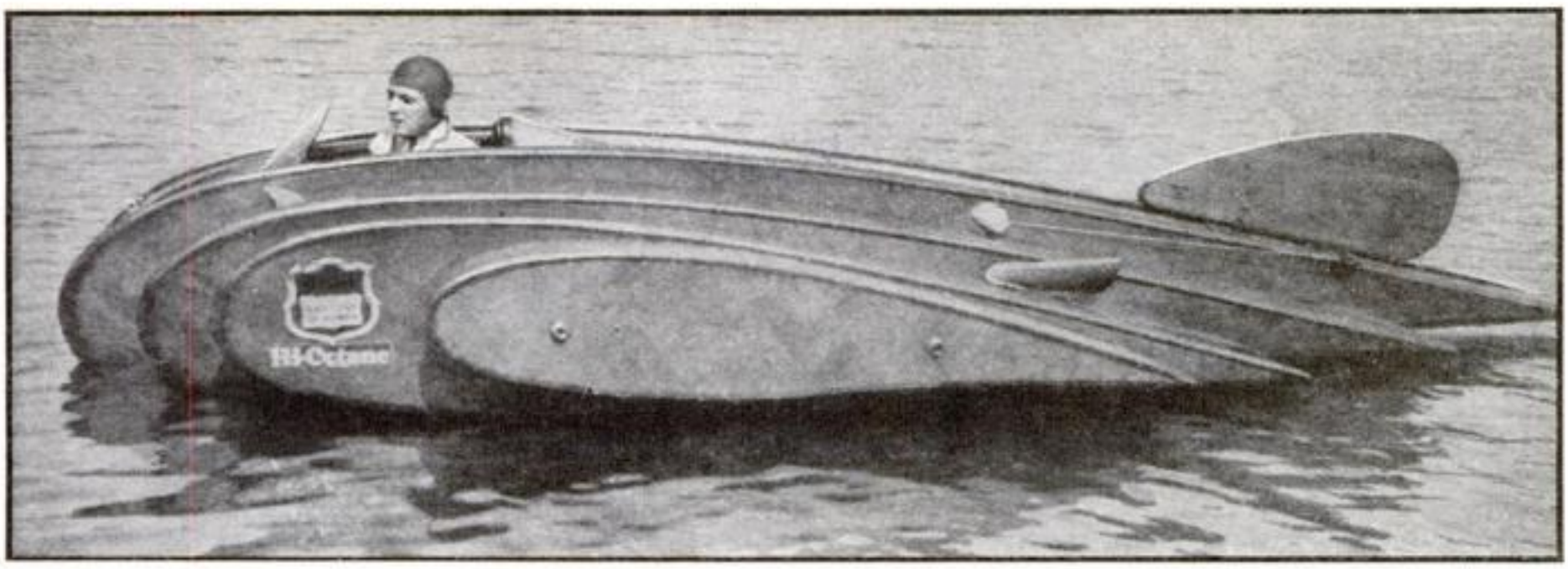
A new screw placer aids workers on automobiles and radios. It retrieves screws that have dropped into inaccessible places, and it also can be used to start a screw in a hard-to-reach hole so that a screwdriver may be used to finish the job. By turning one end of the slender tool, jaws of spring steel are opened and clamped upon the screw, as shown in the photograph. The screw may then be inserted in the depths of a motor or other machinery.

This slender tool has jaws that open to pick up small parts. It also is useful in starting a screw hard to get at



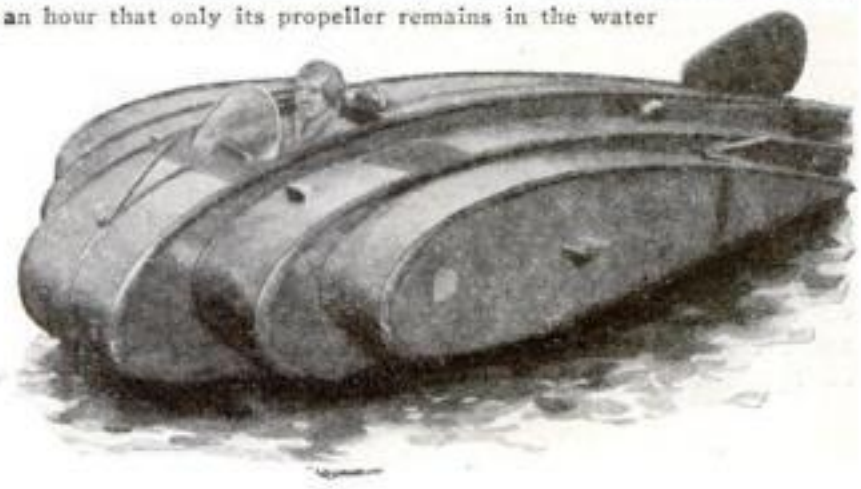
CASTINGS QUICKLY MADE IN MECHANICAL FOUNDRY

Die castings of zinc alloy and brass are turned out in fifteen seconds, by a new mechanical foundry. Die cast parts require little finishing work, but the small manufacturer usually has no facilities for making them and is forced to carry an unwieldly assortment. With the new machine, which requires little floor space, he can turn them out in sufficient quantity to meet his immediate needs.



This new type boat, with wing-like fins, rises so nearly clear at forty-five miles an hour that only its propeller remains in the water

Sea Gull Boat Skims Water at Seventy Miles an Hour



This view of the amazing speed boat shows it just before the installation of the third and smallest pair of its wing-like fins

SKIMMING the surface like a gull, a speed boat that rises clear of the water has just completed its first trial runs successfully at Marshfield, Ore. It resembles a hybrid between an airplane and a water craft. Plywood-covered fins, shaped like airplane wings, extend from the sides in three successively smaller steps. By lifting the boat into the air, they virtually eliminate water friction on the hull and permit seventy-mile-an-hour speed without using unusual power.

Seated behind a small windshield in the one-man cockpit, the pilot operates a fifty-five horsepower motor of outboard type that drives the new boat. It behaves like an ordinary craft until it attains a speed of forty-five miles an hour. At this velocity, which corresponds to the taking-off speed of an airplane, an abrupt change occurs. The pilot can feel the boat rise from the water as the fins take hold on the air. Only the propeller beneath the hull remains in the water where its full thrust is effective. A small water rudder used at slow speed is now ineffective, and an air rudder, resembling an airplane tail fin, steers the boat. Most noticeable to an occupant is the absence of the bumping sensation experienced in fast water craft. The cushion of air between the hull and the water surface acts as a shock absorber; the boat is literally riding on air.

Other advantages of the strange craft are pointed out by the inventor, Victor W. Strode, of Portland, Ore., who has been granted a patent on the unconventional design. The boat turns in an abnormally short radius, with little tendency to tip. It possesses unusual stability largely because of the care with which the propeller was placed after a series of experiments—about one-third of the way back from the bow of the boat to the stern. Complete streamlining minimizes air resistance and fuel consumption. While the hull weighs twice as much as one of standard type, its extra weight is more than offset by the lift of the wings.

Since the first model is an experimental one, the inventor has made no attempt to provide seating accommodations for passengers. Its success in further trials may presage the building of similar, larger craft with enclosed passenger cabins. They would be suitable for use as pleasure craft, as mail or naval dispatch boats, or for high-speed passenger transport over inland water routes and might be used for express service for commuters.

NEW TUBE CONTROLS VOICE IN PHONE

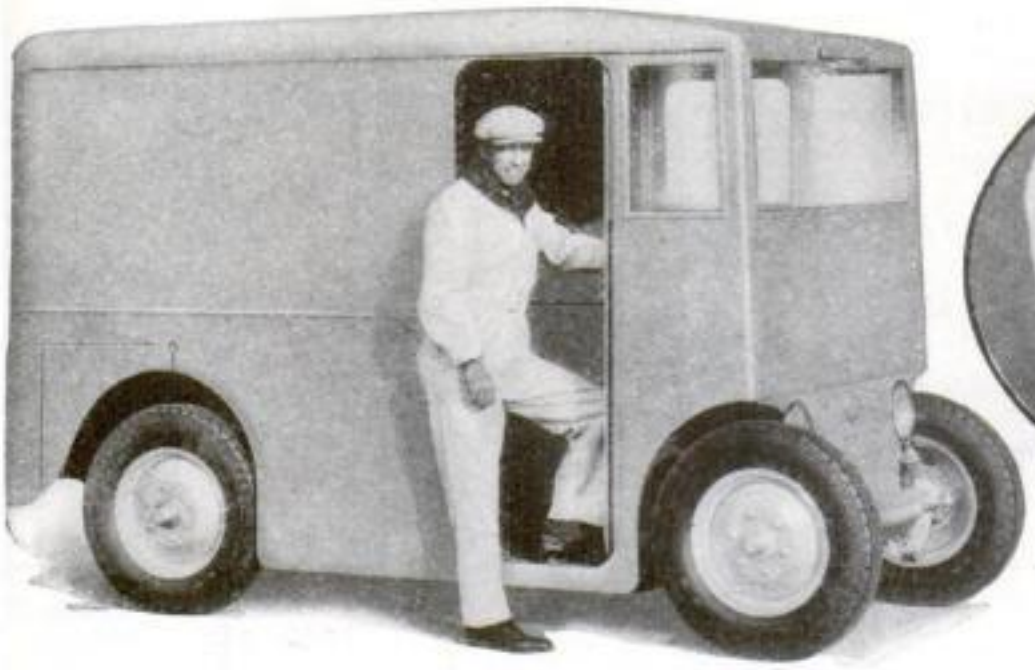
Vacuum tube, shown in place in telephone, controls the tone volume

NO LONGER need you ask a phone caller to speak a little louder, when a new adjustable amplifier is attached to your receiver. By adjusting a simple control that operates much like the volume knob of a radio set, the voice, in the receiver, may be made loud or soft at will. The change in volume is accomplished by a small vacuum tube, to which the girl in the photograph is pointing.

CAR'S STEERING WHEEL IS INSTRUMENT PANEL

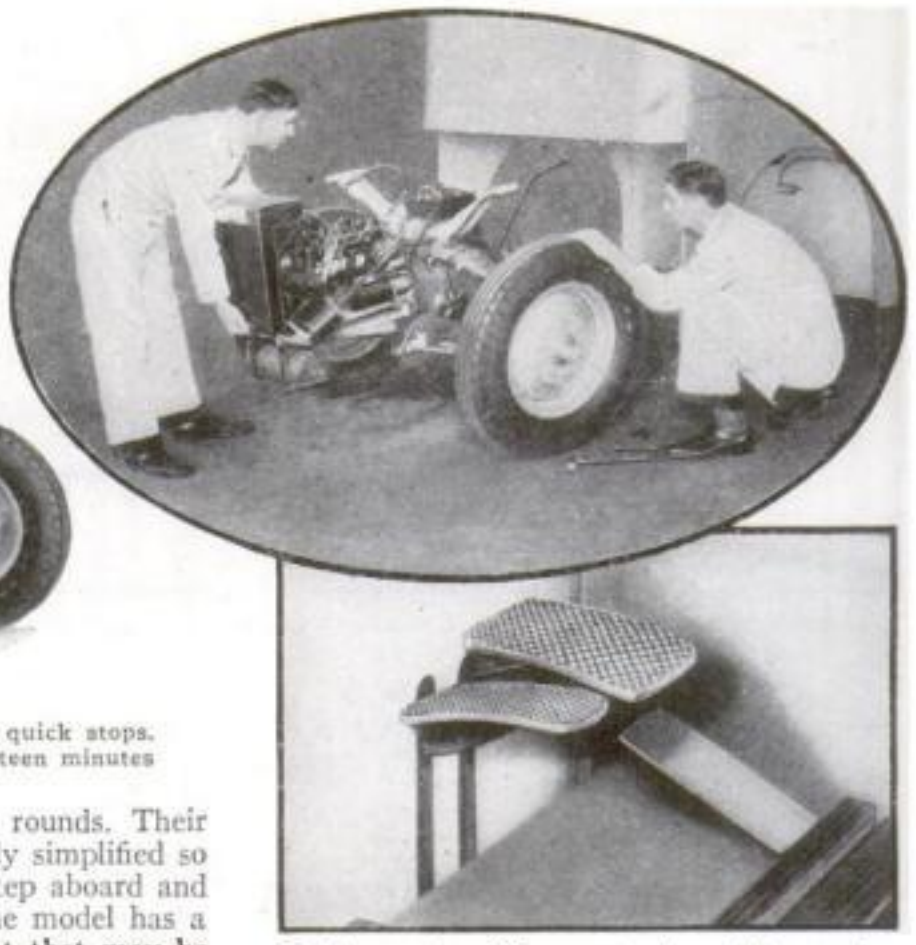
ALL the instruments needed for ordinary driving are mounted directly on a new automobile steering wheel. In this position they are plainly visible. Connections to the instruments are led through the hollow post of the wheel.

Specially Designed Trucks Speed Door-to-Door Deliveries



This new door-to-door delivery truck is designed for easy driving and quick stops. In oval, removable power plant that can be replaced with a spare in fifteen minutes

AUTOMOBILES are about to threaten the last stand of the horse and wagon. New trucks designed especially for door-to-door deliveries have been introduced almost simultaneously by several makers, to speed the milkman, the baker, and others on their daily rounds. Their controls are ingeniously simplified so that the driver may step aboard and drive standing up. One model has a removable power plant that may be quickly replaced with a spare.



So the operator of the new truck can drive standing up, one pedal works brake and controls speed

WINDPROOF SUIT TO AID MT. EVEREST CLIMBERS

WINDPROOF suits will be used by mountain climbers next summer, in a new attempt to reach the 29,141-foot summit of Mount Everest in Asia. The costume is scientificially designed to give protection from icy blasts. Members of the expedition will carry oxygen tanks.

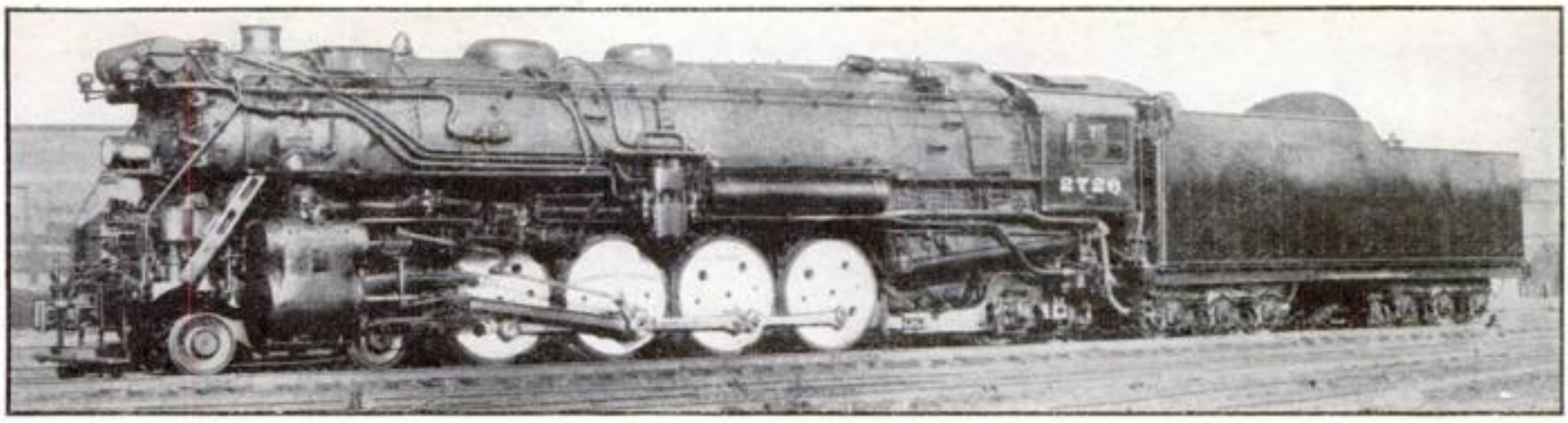
No wires are attached to this new radio knife which gets its current from electrodes on the patient's back

NO WIRES ON RADIO KNIFE

SURGEONS hail a new radio knife, devoid of wires, as an outstanding advance. Previous types have long employed high-frequency currents like those of radio, led through a dangling cord, to make clean, bloodless cuts in tissue. The latest apparatus dispenses with any electric connection and leaves the surgeon's hands unencumbered in a delicate operation. An insulated electrode behind the patient's back charges his skin, and the surgeon's scalpel absorbs enough energy at the point of contact to divide the tissues cleanly.

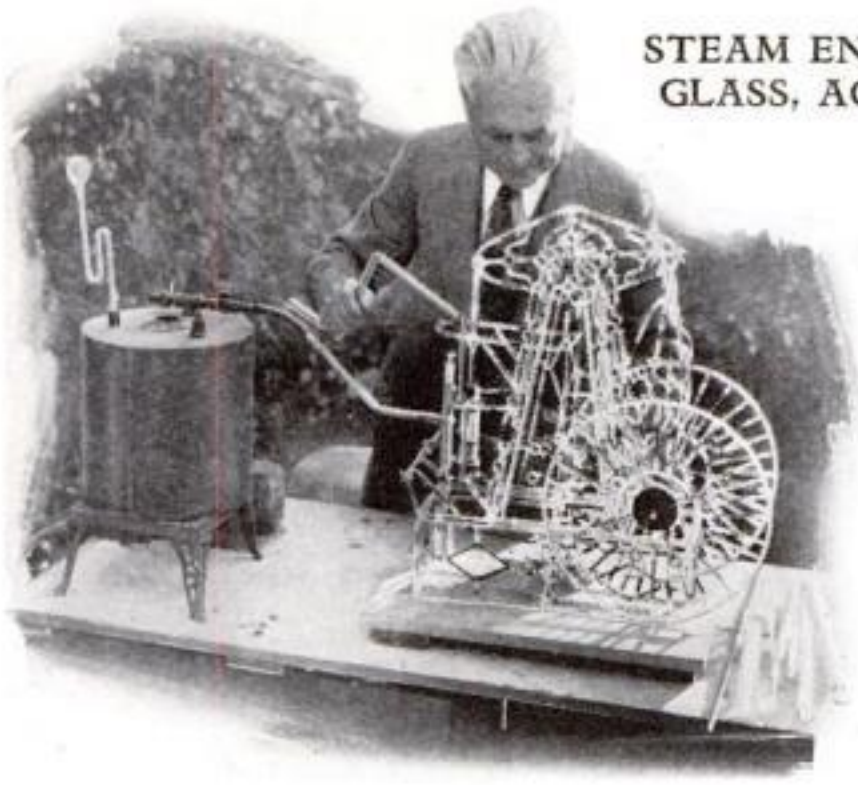
FROZEN FISH ALIVE WHEN THAWED OUT

FREEZING live Volga River sturgeon in Russia, and thawing them out again to be sold alive in inland cities of America, is a possibility forecast by recent experiments of Dr. N. A. Borodin, eminent Russian biologist, at Harvard University. To learn how low temperatures affect fish, he places them in a special electric refrigerator and freezes them alive. In one test, an Alaskan blackfish was frozen in dry air. As shown in the photograph, it thawed out and swam two minutes after being dropped in water.



Powerful Locomotives Are Now Equipped With Disk Wheels

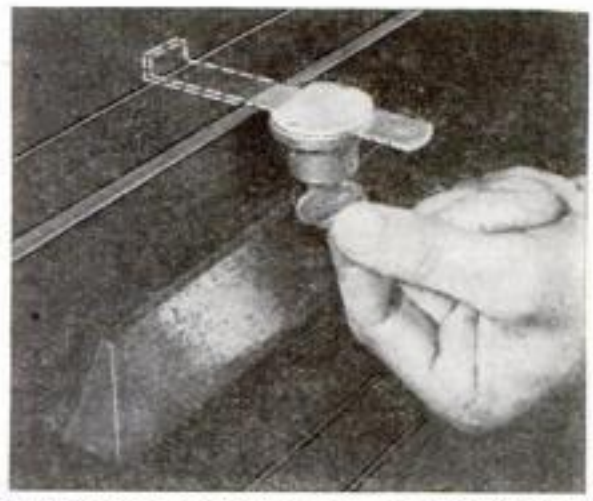
DISK wheels have appeared as an innovation upon locomotives of the New York Central lines. The new drivers are reported to be cheaper than those with spokes and their reduced weight lessens the wear on rails. Each wheel is formed of a pair of disks, encircled by a standard tire of metal. The photograph shows the striking appearance of the first of the locomotives to be equipped with the new wheels; others will be transformed when they come to the shops for repair.



John T. Backman proves that the steam engine he built entirely of colored glass, will actually run when a tiny boiler supplies steam

STEAM ENGINE, BUILT OF GLASS, ACTUALLY RUNS

A CALIFORNIA glass blower, John T. Backman, has just completed an intricate glass model of a steam engine. He began work on the unusual engine two years ago as a spare-time hobby. All the mechanism, including pistons, cylinders, and bearings, is made of glass. Fed by steam from a small boiler, the remarkable model actually runs and develops an appreciable amount of power. Fifteen different colors of glass were used, giving the completed engine a striking appearance.



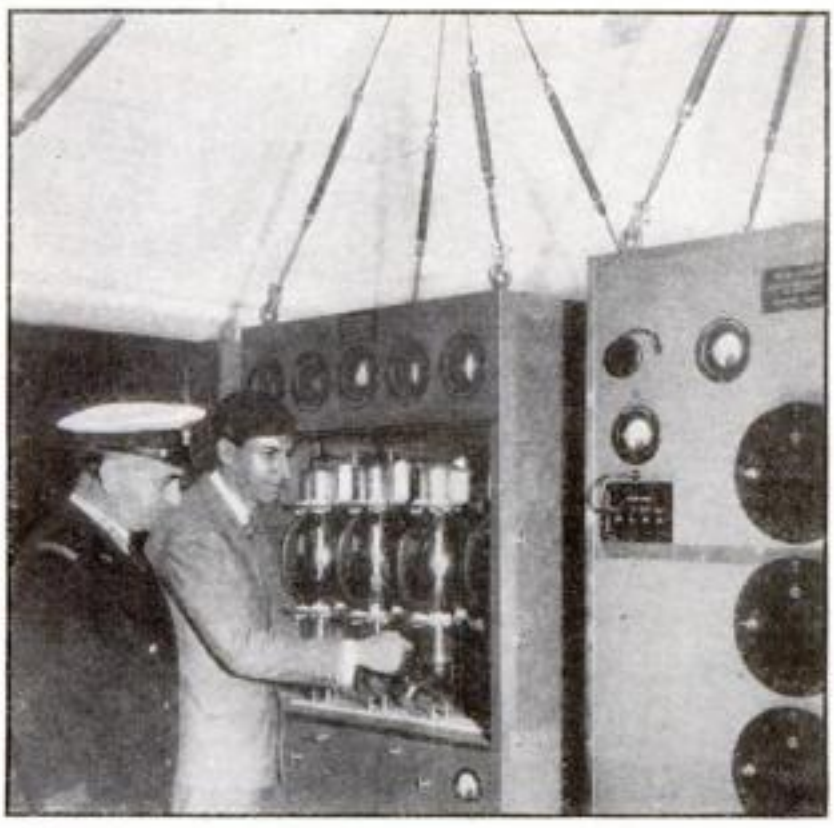
THIS PORTABLE LOCKING DEVICE FITS ANY DRAWER

DRAWERS may now be guarded with a portable locking device. A flat steel bar, with a hook-shaped end, is slipped above the partly-opened drawer and engages the partition above it. The drawer is then closed and the lock, slipped over the notched end of the bar, is pushed home. Only the proper key can open the drawer.

NEW RATCHET WRENCH FOR TIGHT PLACES

ESPECIALLY suited for work in cramped quarters, a new fine-toothed ratchet handle for a socket wrench will take a bite as small as one-seventieth of a complete turn. This compares with a bite of one-tenth to one-twentieth of a turn previously available in such a tool, according to the maker. By turning a knob, the ratchet handle may be reversed without removing it. A slightly smaller model, that contains sixty teeth, has been put on the market.

BIG SHIP'S RADIO HUNG ON SPRINGS



Swung on spring cables, this radio in the Italian liner *Rex* is so well guarded from vibrations that its range is greatly extended

A RADIO outfit hung on springs enables passengers of the S. S. *Rex*, speedy Italian superliner, to converse by radio with friends 4,000 miles away. The cradle of coil springs guards the sensitive set from the vibration of the propellers and the shock of the waves dashing against the ship as it speeds through the water. A battery of seven transmitters provides communication on any desired wavelength from eighteen to five thousand meters, while radiophone communications are received on a thirty-seven tube set that is said to be at least ten times as sensitive as the average home broadcast receiver. The set is also well guarded against static.

SALT, GROWN ON STICKS, HARVESTED FROM SEA

SALT is being "grown" on sticks, in a new process of harvesting it from sea water that has been successfully applied at Alexandria, Egypt. Water from the Mediterranean Sea is admitted to large tracts along the coast, which have been planted with rows of poles. The inlet from the sea is closed and the water, several feet deep, is allowed to evaporate. The salt crystallizes upon the sticks, producing mushroom-shaped pillars of the snowy substance. In the method formerly used, the salt was generally obtained by evaporation in the form of bricks.

When sea water evaporates, salt gathers around the sticks seen in the oval. In drying, it takes on the unusual formation seen in the picture at top of page

TINY CHECK PROTECTOR FITS IN THE POCKET

A CHECK protector, that may be carried in the pocket, guards against fraudulent erasure or raising of the amount. After writing a check, the user slips it into a groove in the device. Drawing the check protector to the right, across the handwriting, perforates the paper with a pair of cog-wheel rollers and makes any alteration instantly visible.

MIDGET PROJECTOR FITS PALM OF THE HAND

The projector being demonstrated at right, and a close-up of which is shown below, is so small it can be held in the hand. The exterior parts fit flush with case when not in use

So SMALL that it can be held in the palm of the hand, a new midget projector serves to display views snipped from movie film. The lens tube and other exterior parts are of telescopic construction, and fit flush with the case when the apparatus is not in use. With the pocket projector, a salesman can show pictures of the manufacture and use of his product.

GROOVE GUIDES WOOD CUTTER BLADE

ESPECIALLY designed for the model maker, a new tool makes it easy to cut strips of light material, such as balsa wood, accurately to size. The blade slides along a straight edge, guided in a groove; it is provided with a guard to preclude the possibility of injuring the fingers. Since sawing, chipping, and cracking are eliminated, there is no waste of material and there is said to be a decided saving of time.

LOCK WORKED BY FLEXIBLE KEY

TO FOIL the lock-picker, an ingenious German inventor has devised what he terms a "dragon key." The odd key is flexible, and is composed of a number of jointed sections. It is pushed without difficulty into the crooked keyhole of the special lock with which it is used. When the key is turned, projections on its sides operate the tumblers of the lock. So warped is the keyhole that an ordinary key can not be inserted.

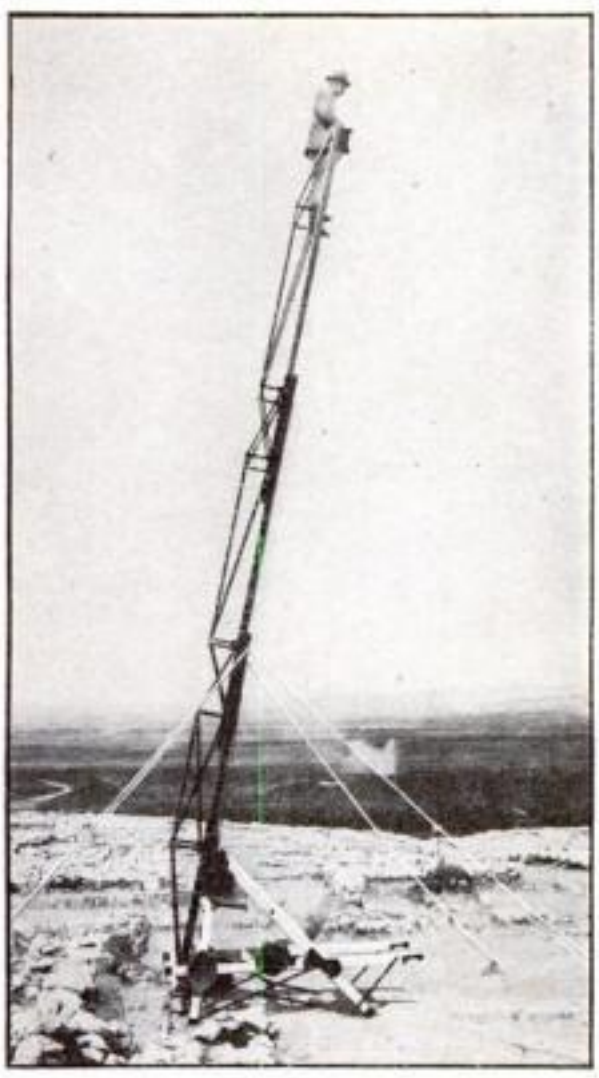
NEW ZEALAND BOYS COAST ON MUD

AMERICAN boys wait for a good snowfall to get out their sleds, but any day is a good day for coasting, in New Zealand. Snow is a rarity in the even, bracing climate of the islands, so the youngsters do the next best thing and coast on mud! Wooden sleds are used, and a bare slope is flooded with water for the sport. Frequent wettings keep the sun from drying up the course.

In New Zealand, children pour water on a steep hillside and when it is thoroughly wetted and turned to mud they get their sleds and coast

EXTENSION LADDER AIDS IN UNCOVERING RUINS

A TWENTY-EIGHT-FOOT extension ladder was recently pressed into service by P. L. O. Guy, University of Chicago archaeologist, to aid him in directing the work of excavating 2,300-year-old ruins at Megiddo, Palestine. Observations and photographs from the high point of vantage enable him to distinguish one layer from the next as the digging progresses.



This framework, invented by a Scotch farmer, is slid beneath an entire stack of hay, the weight of which is thus transferred to the framework's wheels. This enables a tractor, left, to move the whole stack from field to barn

TRACTOR MOVES AN ENTIRE HAYSTACK

TIME-HONORED ways of making hay are brought up to date, according to a Scotch farmer and inventor, in a method that he has just devised. The hay is first stacked on special metal tripods, allowing free ventilation but guarding the contents of the stack against the weather. After a sufficient time for open-air curing has elapsed, a tractor backs up to the stack and picks it up bodily, using an ingenious lifting framework with small wheels and sloping tines. Two men with the tractor can thus gather a crop that would require eight laborers to harvest under the old method of removing it from field to wagon and thence to the hayloft.

New Mechanical Devices

TAKES OFF CRUST. Slowly pushing this tool into a loaf of bread as far as it will go, removes the entire crust at once. This leaves the loaf all ready to use in making round sandwiches

PERFUMES CLOTHES

As a flatiron is passed over the block of paraffin, shown below, it is lubricated so it moves easily over the clothes and as the paraffin is perfumed, a sweet scent is added to the garments. The sheet of asbestos, made into book form, serves as an iron rest

TAPE IN PHONE DIAL CASE. A tape fifty feet in length is enclosed in a case designed like phone dial

CLOCK RUNS GAS HEATER. With the clock control device shown below, a gas heater is turned on or off. It can be set to keep the gas burning for any desired time up to an hour

ROAST YOUR OWN COFFEE. Green beans of coffee are placed in this electric roaster, the timing switch set, and the machine automatically roasts the beans so the housewife can always serve fresh coffee

STOPPER MIXES DRINK. This stopper not only keeps the bottle tightly sealed but it also does the mixing and serving. Pressure on top of cap forces the contents into a glass

REFRIGERATOR CONTENTS EASY TO GET AT Bottles, jars, pots, butter, eggs, or any small item can be placed on this revolving table which fits in the refrigerator. They are then easily accessible as the table will swing them within your reach

LIGHT IN FLATIRON. The illustration at the right shows how a light is permanently attached to a flatiron and provides enough illumination to work by without turning on additional bulbs. The switches for controlling the iron and the light are conveniently placed

Make Housekeeping Easy

WASHES THE AIR
In the air conditioner seen in circle, the air in the home is humidified and at the same time all dust and dirt particles are removed, making it possible to have in the home during winter approximately the same atmospheric conditions as in summer

HOOKS FOR WALL PANEL
Slots in this wall panel hold any combination of hooks in place and can be spaced to suit size of articles

SERVES ICE CUBES. A perforated disc set inside this pail, lifts ice cubes when the handle is raised, making it easy to remove them. Cubes can be stored in the pail until they're needed

SPRAY HOSE DISAPPEARS. Compactly designed, this kitchen sink has two compartments and a spray hose that pulls out of the rear ledge for use and disappears into it when it is released

PUNCH OPENS CANS. Evaporated milk cans, vacuum sealed food cans, and jars are opened with this punch

KEEPS THE BUTTER COOL. Made of metal and glass, this drawer hooks to wire shelf in refrigerator and protects the butter. Glass portion of container slides forward

PROTECTS YOUR FOOD. Cellophane envelopes of various sizes are now procurable for use in protecting food so its flavor is kept

PAPER BAG FOR ICE CREAM. Insulation converts this ordinary paper bag into an ice cream carrier, keeping it cool for hours. It also keeps cooked foods hot

Home Laboratory Stunts

You Can Easily Do with METALS

The blue flame of a Bunsen burner is colored a pleasing red when the spray of a calcium chemical in solution is passed through it

The growth of a "tin tree" is possible, as a result of the crystalline nature of tin, if a drop or two of muriatic acid is placed in the bottom of a tin can. The resulting structure will resemble the pattern of frost crystals on a window pane

Tarnished silver can be cleaned easily with this home-made apparatus consisting of an aluminum pan containing a salt solution into which the silver is placed

NO ONE would think of using a lead pipe for kindling. Yet, with test tube and burner, the amateur chemist can prepare lead particles that mysteriously will burst into flame when they are exposed to the air.

This is only one of the many fascinating experiments with metals that can be performed with inexpensive apparatus in the home laboratory.

Place some lead tartrate in a test tube and heat it until all the vapor has been driven off. The resulting substance will be finely divided lead that will catch fire when the small particles are poured from the tube. Hold the test tube high and gradually tilt it. The lead particles will spark and glow as they fall to the floor.

If desired, the test tube, after heating, can be tightly stoppered and laid aside. When it is opened, the lead within it will catch fire if it is poured into the air.

If your stock of chemicals does not include lead tartrate, it can be made by mixing a solution of lead nitrate or lead acetate with a solution of tartaric acid or cream of tartar. The lead tartrate will be formed as a white precipitate.

Allow the white powder to settle to the bottom of the beaker and then carefully pour off the top liquid. Wash the lead tartrate thoroughly by adding water, shaking it, and allowing the precipitate to settle again. Then carefully pour off the wash liquid and repeat the process several times. The solid lead tartrate can be obtained either by filtration or by slow evaporation of the water that remains.

Finely divided iron that will burst into flame in the same way can be made by the home experimenter. The iron is prepared by passing hydrogen gas over hot iron oxalate. Place the oxalate in a glass tube connected to a hydrogen generator. As the gas is formed, heat the tube containing the iron oxalate.

Be sure the hydrogen gas has expelled all the air from the system before applying the Bunsen flame to the tube. Hydrogen and air form an explosive mixture that will be ignited by the heat of the flame.

A formation of iron in a similarly active state sometimes is found on the iron hoops that hold vinegar barrels together. The vinegar, seeping through the wood, attacks the iron and forms a substance that appears as small lumps and knots on the surface of the metal. Generally these can be ignited with a match.

THE fact that metals and salts of metals burn with flames of various colors forms the basis of colored fireworks. Strontium nitrate, for instance, is used in the manufacture of red flares because it burns with a vivid crimson flame. Powdered magnesium or aluminum will burn with a brilliant white flash if thrown into the blue flame of a Bunsen burner. For this reason, magnesium forms a part of the flashlight preparations used in taking indoor photographs.

Sodium compounds, such as salt (sodium chloride) and baking soda (sodium bicarbonate), color the flame of a Bunsen burner yellow. Similarly, calcium compounds color the flame brick red while barium salts produce a greenish hue.

A novel and interesting way to demonstrate this property of metals is to dissolve a carbonate of the metal in a dilute acid and allow the spray formed by the reaction to be carried up through the air port of a Bunsen burner.

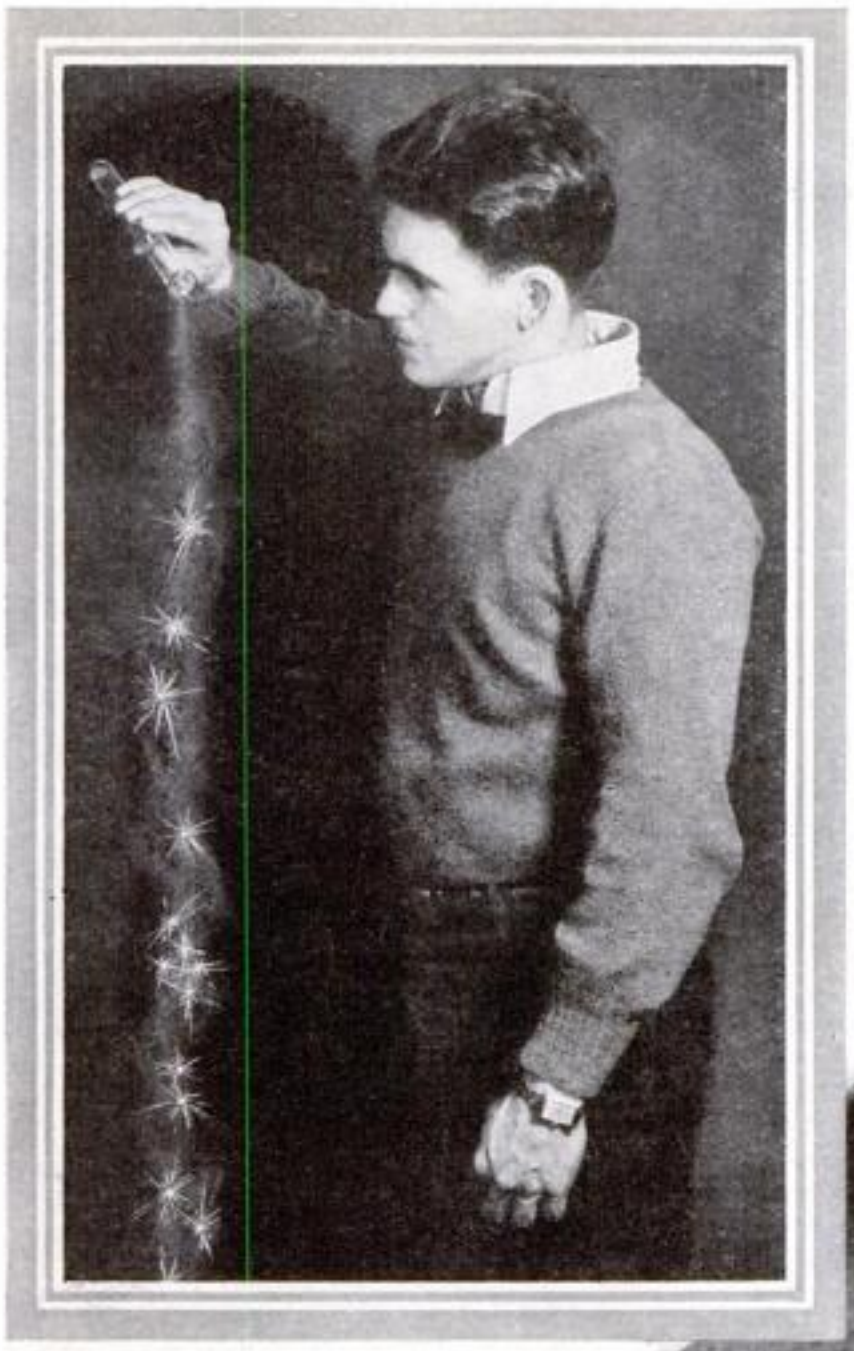
For example, place some marble chips (calcium carbonate) in muriatic (hydrochloric) acid, using the gas generator described in a recent issue (P.S.M., Aug. '32, p. 60) as the container. Then bring the small air port on the side of your burner over the mouth of the bottle. The mist of calcium chloride will be carried up through the port and into the blue flame, coloring it red. This red color is peculiar to all calcium compounds.

Obviously, since metals impart characteristic colors to a Bunsen flame, burning is a simple means of testing for their presence. In this way, sodium nitrate and strontium nitrate, two chemicals that look alike, can be distinguished from one another by holding a loop of wire containing first one substance and then the other in a blue flame. Sodium chemicals, we have found, color the flame yellow while strontium gives it a crimson color.

Two rare metals, platinum and palladium, when prepared in a special form, have the peculiar quality of being able to *adsorb* gases with such vigor that they become red hot. A thin wire of either of these metals, held in certain types of illuminating gas, will get so hot that it will ignite the gas. The same is true when they are held in gasoline vapor.

Burning Lead or Iron is Easy After You Have Made Correct Preparations Which Require Simple Apparatus

By RAYMOND B. WAILES



Lead tartrate is placed in a test tube and heated until all the vapor is driven off. The resulting substance, finely divided lead, will catch fire in the air when it is poured out of the tube. A ring bent in the end of a wire, as shown at right, makes the best tool for holding a chemical in a flame

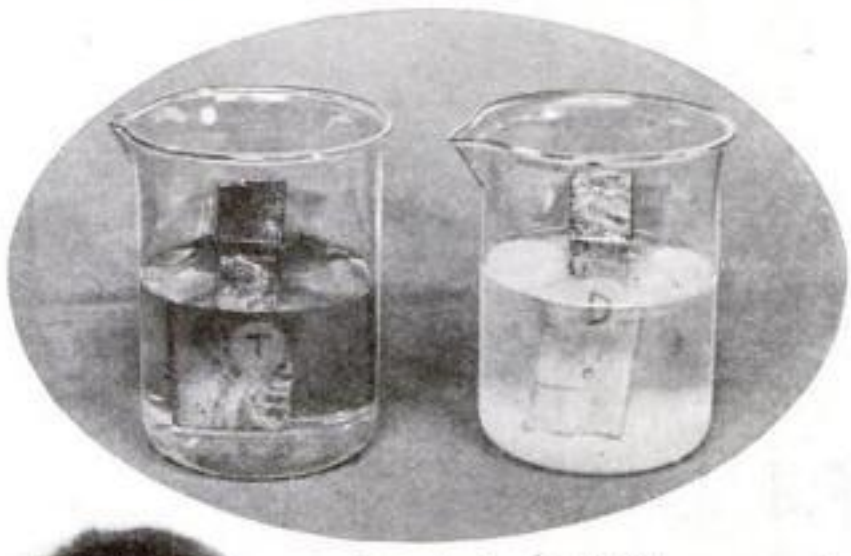
Use of this property is made in one type of commercial gas lighter and cigarette lighter. In the cigarette lighter, the fine wire is lowered into a cylindrical wick saturated with gasoline. The vapor causes the wire to get red hot and ignite the vapor and the wick.

IF THE metal in such a lighter becomes inactive, it can be returned to its originally active state by heating it in a flame to drive off the *adsorbed* gases.

In a recent series of experiments demonstrating distillation (P.S.M., Jan. '33, p. 48), we learned that distilled water is free of impurities. It would seem reasonable to suppose then that distilled water would have little effect on a metal as inactive as lead. This, however, is far from the truth. In fact, lead is attacked and quickly dissolved by distilled water while it is not dissolved by tap water which invariably contains other chemicals.

This can be shown by placing a small strip of lead in a beaker of distilled water and a similar strip in another beaker containing ordinary tap water. After some time, the distilled water will become cloudy —a white precipitate will be formed.

The chemicals dissolved in the tap water, however, combine with the lead and form a protective coating that prevents any further reaction.



Into a beaker of distilled water a strip of lead is placed and into another beaker containing tap water a similar strip is placed. Dissolving lead will give a milky color to the distilled water but the tap water will remain free of lead

This experiment shows graphically what happens when soft and hard waters come in contact with lead piping. Soft water can be likened to the distilled water since it contains few dissolved chemicals.

Similar to the magic lead tree described some months ago (P.S.M., July '32, p. 60), is an artistic formation of tin crystals that can be grown on the bottom of a tin can.

As we know, a tin can is not made entirely of tin but of iron coated with tin. Tin is used because it is inactive to the various acids and the oxygen inclosed in the can. It is this thin coating that supplies us with the tin for our tin tree.

Place a drop or two of muriatic acid on the bottom of the can. Almost immediately, a leafy-like growth of tin crystals will be formed. You will find that the structure resembles the fan-shaped patterns on the surface of a frosted window pane.

SHEETS of metallic tin have been exposed to moist air for years without tarnishing in the least. It is on this non-tarnishing quality and its particularly low melting point that the commercial uses of tin depend.

Although not a metal, sulphur also can be prepared in a crystalline form.

Perfect crystals of sulphur can be made by melting sulphur and allowing it to cool until crystals appear on the surface. On pouring off the sulphur, which is still in the liquid form, the solid part will appear as long, narrow, prism-shaped crystals. This form of sulphur is known as prismatic sulphur.

Bismuth behaves in the same way. To observe the crystalline structure of this metal, place it in the shallow lid of a tin can, such as is used for baking powder, and heat it over an alcohol or candle flame. The crystals of bismuth will form when the resulting liquid is allowed to cool.

When you perform this experiment, you will find that no great amount of heat is required to melt the bismuth. It is this property of bismuth that makes it the principal ingredient of an alloy used as the fusible plugs in automatic sprinklers.

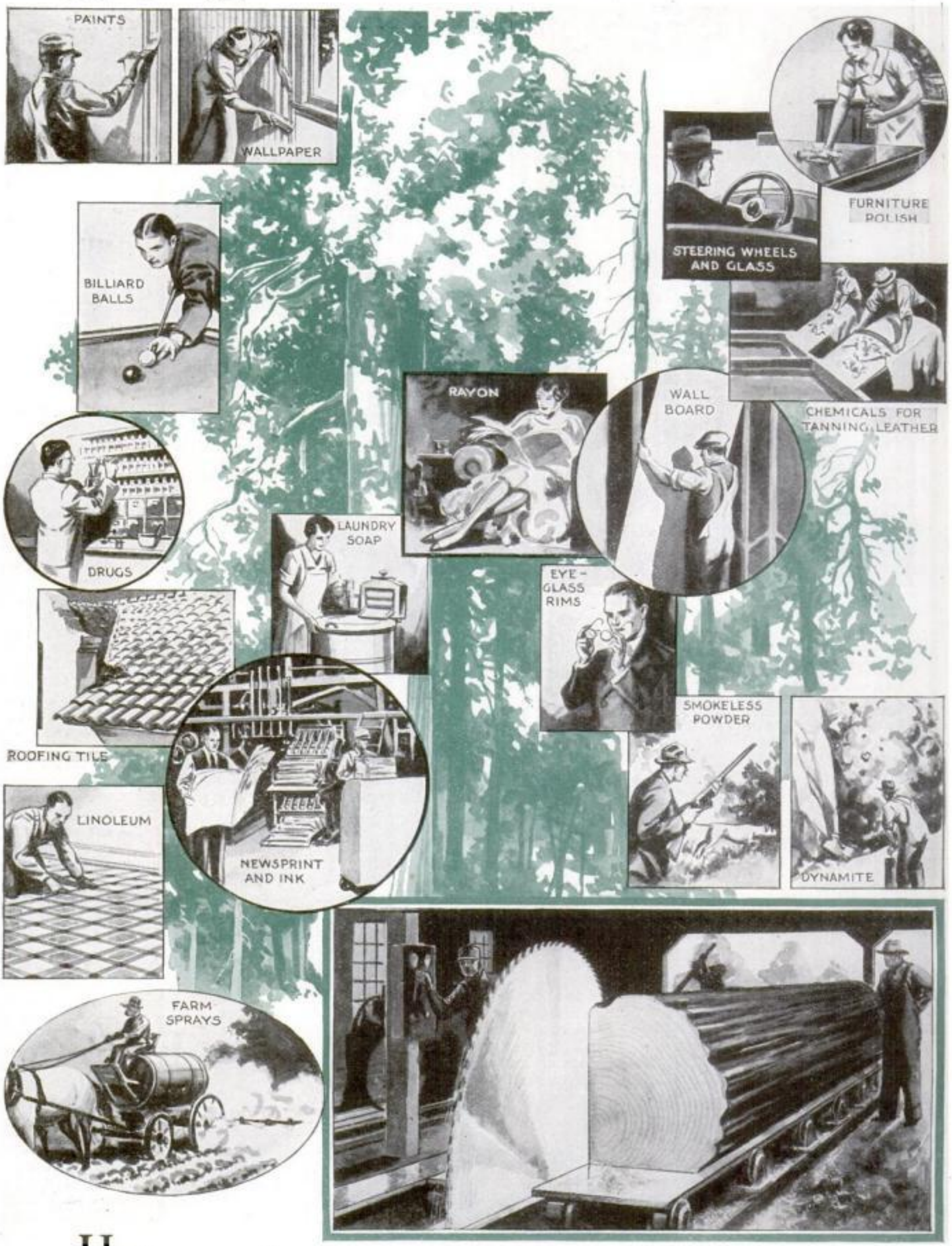
IN OUR experiments in electro-chemistry (P.S.M., Dec. '32, p. 58), we found that an electric current is formed when two different metals are placed in a solution that will conduct electricity. The housewife can use a practical application of this simple process to clean tarnished silverware.

Place the tarnished silver in an aluminum pan containing a hot solution of baking soda, salt, or both. This combination, in reality is a simple cell where the aluminum forms the negative element, the silver becomes the positive electrode, and the baking soda or salt solution is the electrolyte.

As in the battery, an electric current flows from the positive tarnished silver to the negative aluminum pan and in so doing removes by a chemical reduction process, the tarnish, which is silver sulphide.

Of course, if the same pan is used repeatedly for this purpose, it will become worthless. For this reason, it is better to use an enameled pan and place a plate of aluminum in the bottom under the silver. When the plate becomes black, it can be replaced with another. Zinc also can be used if desired.

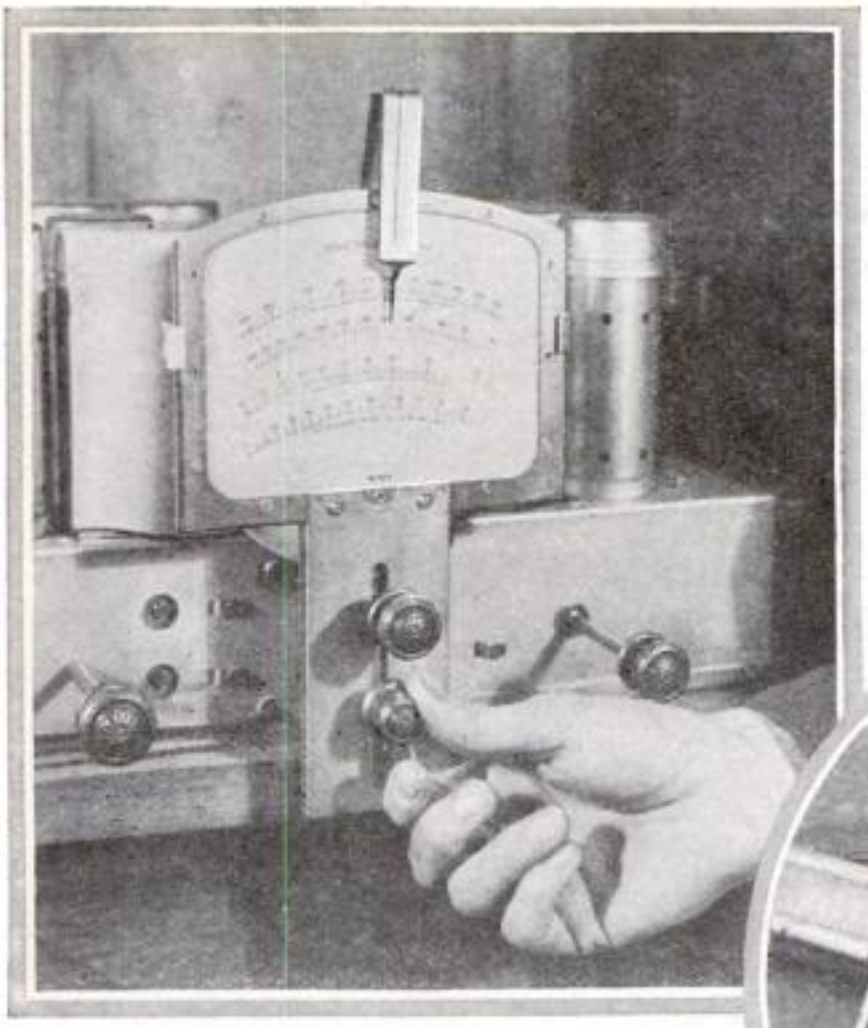
Amazing New Uses Found for Wood



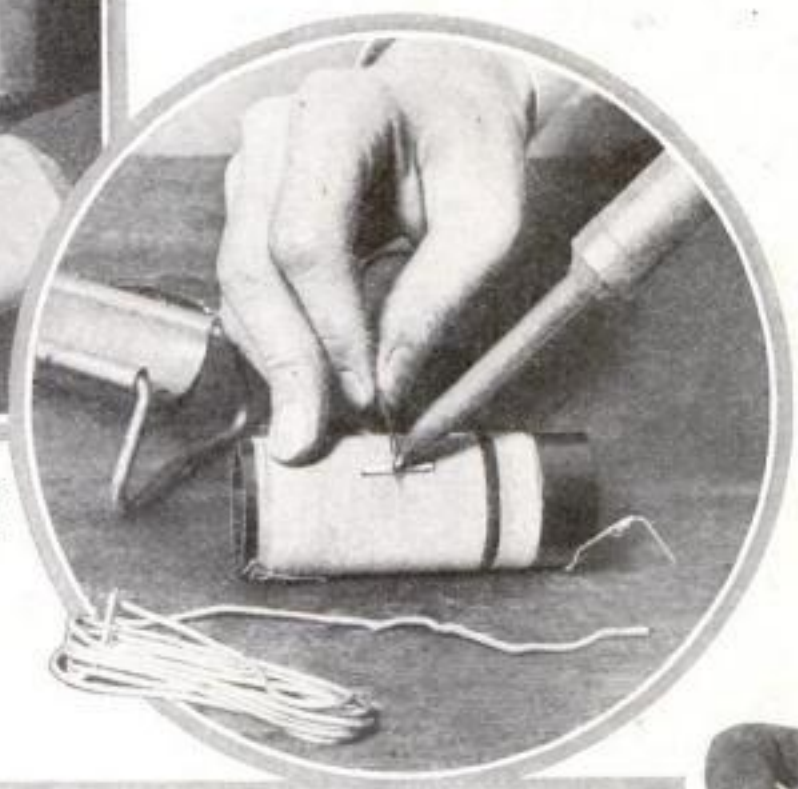
HERE, as suggested by our artist, are unexpected new uses to which the by-products of American timber are now being put. The waste from logging camp and sawmill—in some regions more than half of the wood actually cut—is reclaimed by the magic of chemistry and goes into the manufacture of hundreds of useful articles

All-Wave Set *has* FOUR TUNING SCALES

How to Solder Taps on Coils and Other Useful Hints for Radio Fans



Photograph shows the control that operates the all-wave receiver switch and also raises and lowers the tuning dial so that the correct scale appears in the front panel window



Illustrated at the left is the manner of using a paper match to raise the wire on a coil when soldering a tap. In this way the insulation is protected from being charred with the iron

BY TURNING a convenient switch on the front panel of the all-wave receiver pictured above, the set can be changed over quickly for operation on any wave band from 15 to 550 meters. The same twist of the knob also shifts a movable tuning dial so that the proper scale appears in the dial window of the receiver.

As shown in the photograph, the four tuning scales, one for the broadcast band and three for the short wave bands, are located one below the other on a sliding frame that is moved up or down by operating the change-over switch.

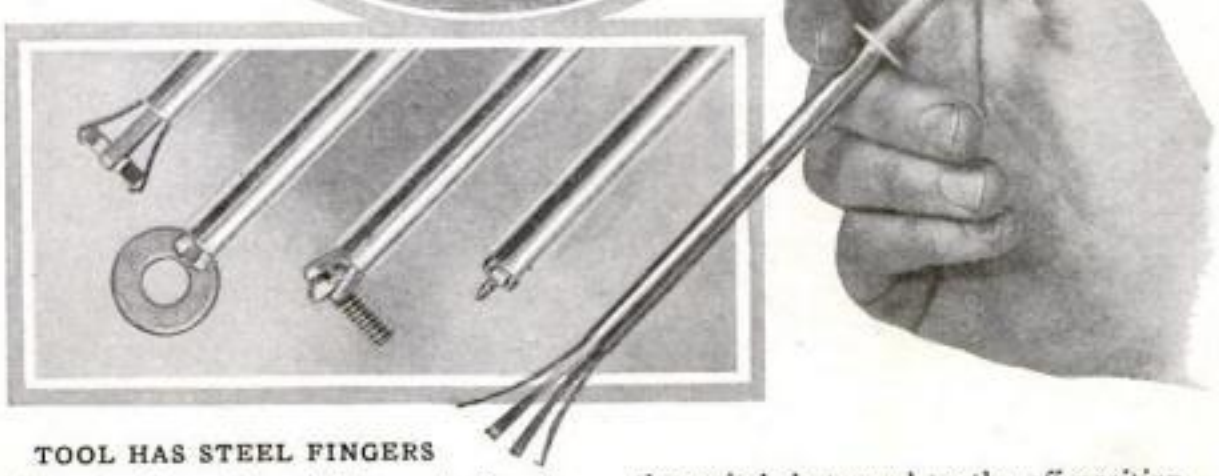
For instance, if it is desired to operate the receiver between 80 and 185 meters, the switch knob is turned until the lighted tuning dial for that range appears. The receiver is then ready for operation.

Above the four scales is the printed word "phonograph." When the control switch is turned to its extreme position so that this word appears in the dial window, the receiver is connected for use with a phonograph pick-up attachment.

This dial makes the all-wave receiver four sets in one, since only the tuning scale corresponding to the position of the change-over switch appears in the dial window. The shifting scale is made of a translucent material and is lighted from behind by a small bulb.

HANDY RADIO TOOL

GRIPPING nuts, screws, or loose wires in the congested depths of a radio cabinet offers a real problem to one's ingenuity. With the novel tool illustrated, however, it becomes a simple matter. A push of the convenient plunger and four spring-operated fingers reach out and grasp the desired part in any position allowing it to be put in place, tightened, loosened, or removed. Being long and slim, it will reach parts situated in a maze of wires and it is especially suited for retrieving the small nuts and screws that persist in dropping down inside the chassis where your hands can't reach them.



TOOL HAS STEEL FINGERS

When the plunger is pushed down, the four fingers on this tool open to pick up small parts or hold nuts and screws as shown in photo above

NAILS AS DRILLS

BY SELECTING an assortment of shingle nails of various sizes and removing their heads with a saw, the radio fan who constructs his own sets can provide himself with inexpensive substitutes for the frail drills he ordinarily uses for drilling small holes in thin panels and coil forms. The sharp points of the nails will cut almost as fast as a drill.

CAR SET KEEPS RUNNING

OWNERS of automobile radios may find that their receivers continue to operate for a fraction of a minute after the switch is turned to the off position.

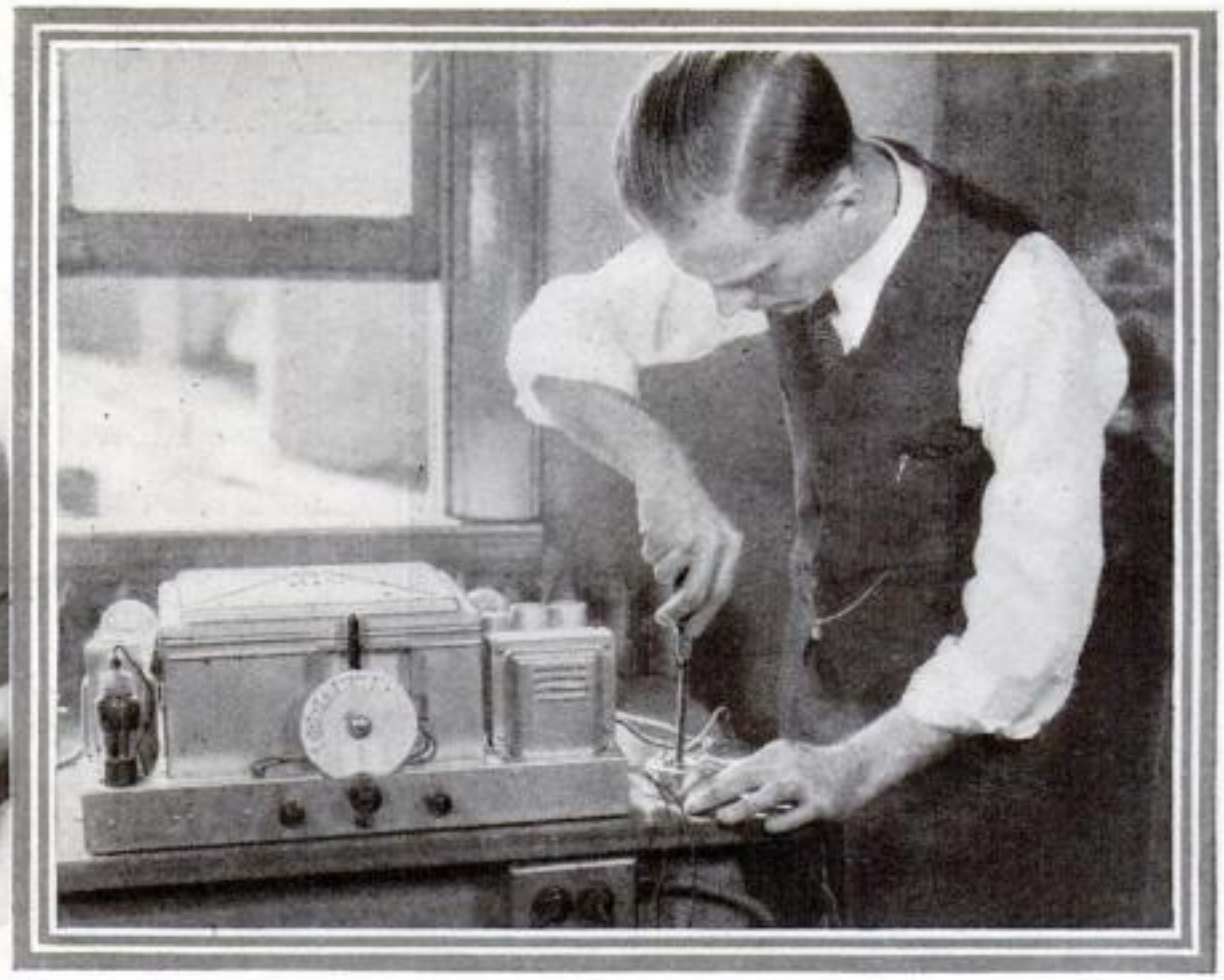
This is due to the fact that the cathodes of the tubes cool off slowly and being hot, continue to emit electrons. Since the B battery is always in the circuit, the tubes operate until the cathodes cool.

Most automobile receivers are inclosed in a metal box and placed directly in back of the motor under the dashboard. This probably causes the cathodes to retain their heat longer that they would under ordinary conditions.

SOLDERING KINK

WHEN soldering taps on coils, care should be taken not to char the insulation on adjacent turns. Burning the silk or cotton covering transforms it into carbon, which is a conductor and may cause a partial short circuit. The best way to make such a connection is to lift the wire to be tapped and slip a piece of paper or a match under it where the joint is to be made. This will protect the adjacent insulation and furnish a convenient raised surface for soldering.

The receiver transformer, which can be used to keep unwanted noises from reaching the speaker, should be placed as shown at the right, close to the antenna and ground connections at the set. Below, connecting by-pass condenser to eliminate interference coming from sparking brushes



Keeping Your RADIO

Man-Made Static Can Be Shut Out of Your Set by the Use of a Condenser Across Sparking Contacts and Choke Coils on Motor

• FOUR POINTERS ON NOISELESS RECEPTION •

1 **High outside antenna, rigged in a straight horizontal line**

2 **Perfectly shielded receiver and carefully designed power supply**

3 **A good ground. Either actual earth or water pipe entering cellar wall**

4 **A low-loss, interference-free lead-in from antenna to set**

NOISELESS reception, free from the garbling crashes and crackles of static, has long been the goal of radio engineers.

Unfortunately, natural static is a weird product of the atmosphere and aside from increasing the strength of broadcasting no way has been found to eliminate it. However, tests have shown that atmospheric static constitutes less than twenty percent of the total interference to broadcast reception.

The sparking brushes of a motor, the vibrator of a violet-ray machine or battery charger, and defective heating devices all contribute to the noises that hamper clear reception. Even the tiny sparks from the commutator of a small fan motor can set up a racket in a nearby radio that sounds like bricks tumbling down a metal chute.

These are all sources of artificial static and being man-made they can be controlled. Man-made static, it has been found, is caused by the making and breaking of an electric current—a spark. Obviously, one way to eliminate it is to remove its effect, and this can be done in most cases by connecting a by-pass condenser or other filter arrangement across the sparking contacts.

The function of the condenser is to provide an easy path for the high frequency currents and prevent them from being radiated to the receiver. The size of the condenser depends, of course, on the severity of the spark.

A violet-ray machine, for instance, generally can be silenced by connecting a one or two microfarad condenser across the buzzer contacts. The condenser should be rated at a working voltage equal to about twice the voltage of the circuit.

If the vibrating arm is hard to reach, the condenser can be connected across the two supply wires leading from the plug at a point where they enter the case of the machine. To be effective, the condenser should always be connected as close to the source of the trouble as possible.

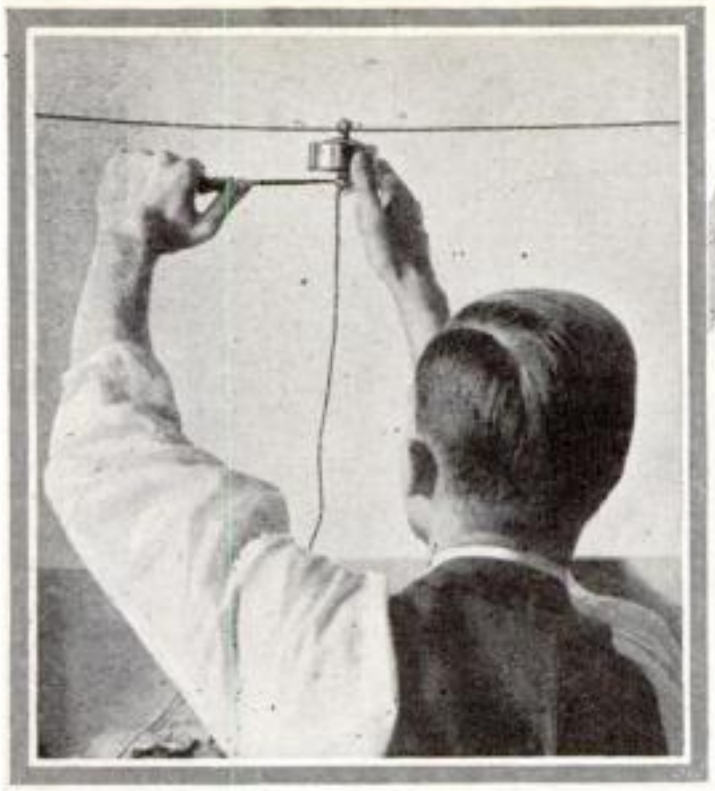
A one-quarter microfarad condenser connected across the brushes of the small motors used in fans, soda mixers, hair dryers, and similar devices using universal or D. C. motors will eliminate the interference that is caused by sparking brushes.

In obstinate cases, a combination of condensers and choke coils connected to the motor will often succeed where condensers alone fail. The choke coils act as impedances to the radio frequency currents while the condensers by-pass them to the ground.

Interference from the contactors in elevator circuits can be eliminated by connecting large condensers across the contact terminals. In such cases, large condensers of at least twenty microfarads capacity should be used.

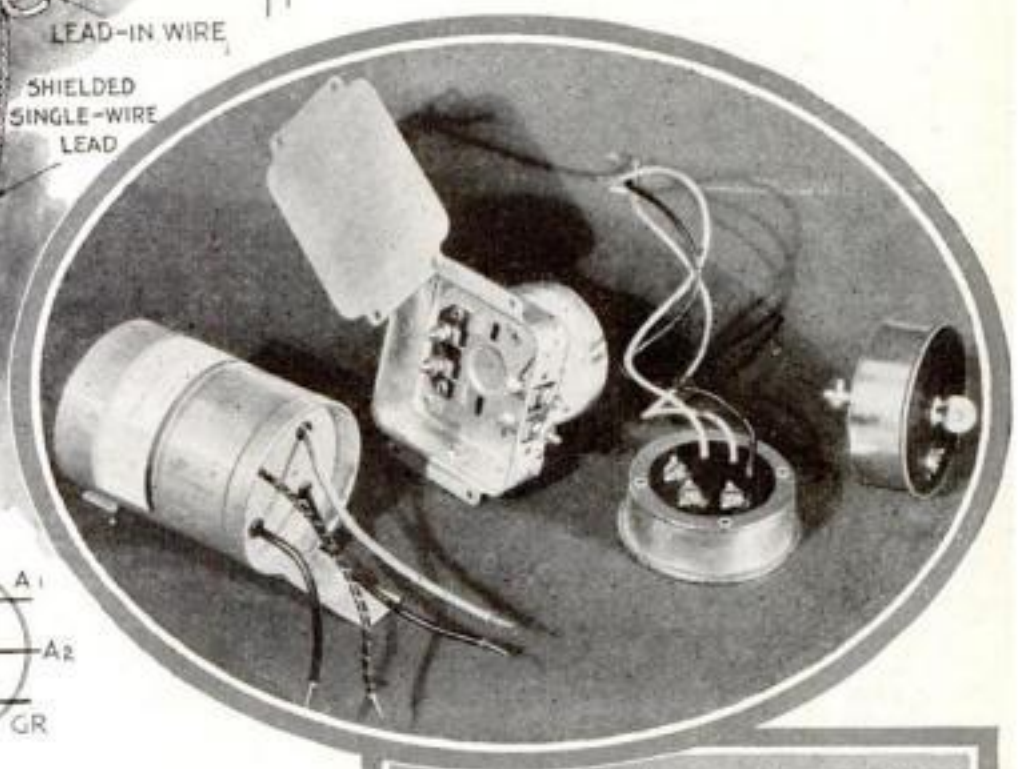
Since any mechanism in which a circuit is made and broken is a possible source of radio interference, the hunt to find the trouble and eliminate it sometimes becomes complicated. For this reason, attempts to eliminate interference by the filter method are often unsuccessful and never easy.

The sparking wheel on a trolley car pole can set up interference that will ruin reception over a large area. Here is a source of trouble outside the jurisdiction of the radio owner.



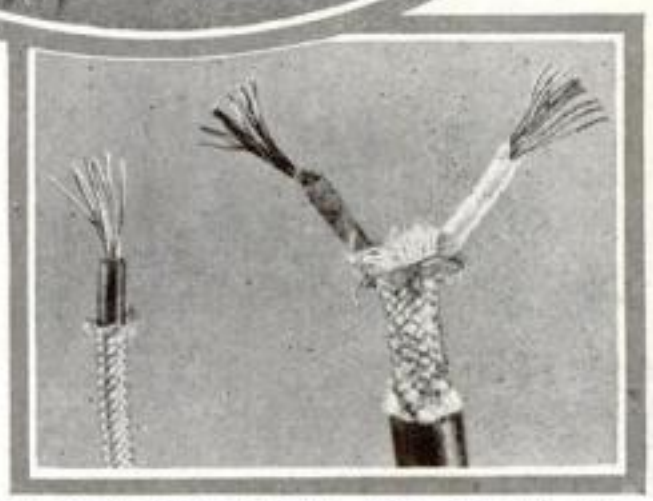
This illustrations shows how one type of antenna coupler is connected to the antenna wire. On this system, the case of the coupler is attached directly to the antenna by means of a screw terminal. At right, diagram shows how the coupler is installed

In the picture below are two types of shielded lead-in systems employing coupler transformers. With the use of such systems many of the objectional noises are kept from set

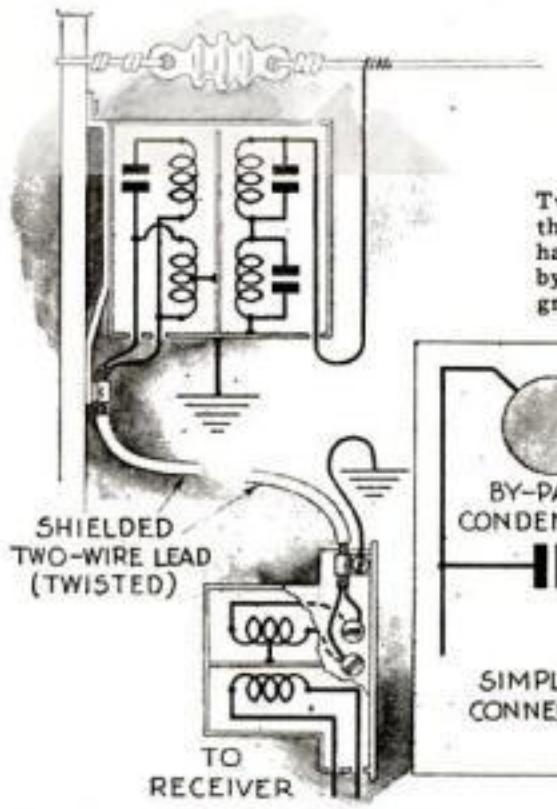


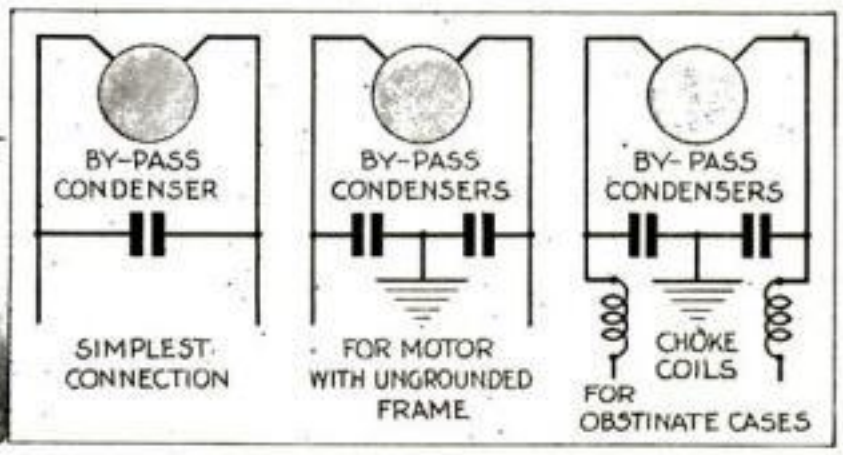
Free of Noises

By
GEORGE H. WALTZ, JR.



Two types of shielded lead-in wire. The one at the left has a single wire and the one at the right has a double wire. Below, diagrams for installing by-pass condensers and choke coils. At left, diagram showing the use of shielded two-wire lead-in





Of course, if you live in a private dwelling located some distance from trolley and power lines you can control the interference-making devices near your receiver.

Fortunately, radio fans, especially those living in conjested districts, can eliminate interference in still another and easier way. Unwanted noises enter the receiver by three routes—through the antenna and ground system, through the receiver, and through the power lines supplying the set. Obviously, by careful designing and installation all three of these back entrances can be successfully blocked.

First, a radio receiver should be adequately shielded. Parts and wiring must be protected and the power supply circuits must be designed to exclude interference.

To test your receiver for perfect shielding, first disconnect the antenna lead and ground wire from the set. Then connect the antenna and ground binding posts together with a short piece of wire and turn the volume control to its full on position. If no signal is heard, excepting perhaps the faint response from a high-powered station that is located nearby, it shows that the receiver is about as well shielded as possible.

It is in the rigging of the antenna where the amateur can do the most to eliminate interference in factory engineered and constructed sets. For broadcast purposes, a single, horizontal wire about one hundred feet in length forms the best type of antenna. The lead-in can be connected at either end or in the middle, whichever is most convenient.

Always avoid zigzagging an antenna. It will reduce rather than increase the signal even though more wire may be used by so doing. If you can't rig a one hundred foot antenna in a straight, horizontal line, use a shorter length.

Rig the antenna wire as high as you can get it and keep it away from the house if possible. Under no conditions, place it within ten or twelve feet of metal roofing and avoid running it adjacent to roof houses or similar projections that may contain some form of electrical equipment.

When an antenna is rigged in a back yard, it should run two or three feet above the trees. If power or telephone lines are located close-by, arrange the antenna so that it will be at right angles to these. Remember, interference that reaches the antenna can not be eliminated, so it is best to plan your work with care and judgment.

As a lead-in approaches your house, it gets closer and closer to a field of interference. Every home, and especially apartment buildings, contains appliances and equipment that are bound to radiate unwanted noises. To exclude these, a shielded lead-in wire can be used.

Shielded lead-in wire, in most cases, consists of an insulated cable covered with a copper braid or lead sheathing. The shielding is grounded and thus serves to lead off the *(Continued on page 99)*

Don't Starve Your Car's Battery

Gus Wilson Describes Easy Way to Test Ignition System and Keep It in Good Shape

By MARTIN BUNN

JUST A SHORT CIRCUIT

"Say what you like," Mrs. Cummings insisted, "you did something to this car. Can't you smell it burning?" "I guess you're right," said Cummings as he stopped at the side of the road. "Smells like battery acid, to me," he added after a moment

RABBIT-LIKE, the Cummings' car bounded over the bumpy railroad crossing. Then—blump! A hollow thud resounded above the rattles. Harry Cummings jammed on his brakes. His wife shrieked.

"What have you done now?" she demanded.

"Aw, say!" protested Harry. "What's the idea of blaming me for everything? Can I help it if we hit a loose stone and it bounces up against the floor boards?"

"Well, you could be more careful," snapped Mrs. Cummings. She sniffed once or twice. "Say what you like," she insisted, "you *did* do something to this car! Can't you smell it burning?"

"Gosh, I guess you're right!" exclaimed Harry. He steered the car over to the side of the road and stopped. "Smells like battery acid to me," he muttered after a moment. Quickly he lifted the front seat and raised the cover to the storage battery compartment.

Some minutes later, Gus Wilson and Joe Clark, the owners of the Model Garage, were listening to Harry Cummings' strange tale of woe.

"Look at that, will you," Harry directed, pointing down at his uncovered battery. "The compound on top of that left cell is split right across the middle where the filler cap goes. When I first looked at it, the filler cap had entirely disappeared and the top of the cell was bulged up like a broken stick where that crack is.

"I hunted around and finally located the missing cap at the bottom of the battery compartment. I pushed the top of the cell back in place, screwed in the filler cap, and then drove here."

Gus Wilson leaned over to inspect the battery, Joe Clark peering inquisitively over his shoulder, while Mrs. Cummings fidgeted impatiently in the back seat.

"Joe, suppose you take my car and drive Mrs. Cummings home." Gus suggested after glancing at the back seat and recognizing the warnings of an impending verbal storm. "There's no need for you to wait around until we've found the trouble, Mrs. Cummings."

When they were gone, Gus busied himself with the leads from the battery. The battery compartment was metal and the heavy cables that led from the battery passed through holes in the metal sides.

As Gus pulled and jiggled the cable leading to the starting motor, long yellow sparks zigzagged in all directions.

"Here's your trouble," Gus announced triumphantly. "The insulation on this cable has worn through right where it leaves the battery compartment. Every time you went over a bump, the bare wire came in contact with the metal sides of the compartment and caused a short circuit."

"That's a short circuit all right," Cummings agreed, "and a bad one too. But what split the top of the battery open?"

Gus scratched his head. "Well, you can bet your hat the short circuit had something to do with it," he decided at last. "My guess is that you've been doing a lot of daytime driving. That charged up your battery and it began to gas. By that I mean that it bubbled off hydrogen gas.

"Hydrogen is an explosive gas when it's mixed with air and your battery compartment, being closed over, confined the gas that was given off. When you went over those bumps at the railroad crossing, the bare wire on that worn battery lead came in contact with the metal sides of the compartment and caused a short circuit.

"The sparks from the short ignited the gas mixture and blew the top off that left-hand cell. The thud you heard was the rubber filler cap hitting the cover on the battery compartment. You should inspect your battery leads now and then," he finished.

"Isn't there some way you can reduce the charging rate of the generator when you're going on *(Continued on page 100)*

GUS says: **It's a good plan to try out all the tools you carry in your repair kit to make sure they fit. You may be toting a lot of useless weight. It's heartbreaking to get a flat tire miles from nowhere and find that the trick jack you bought several years ago won't fit under your new car.**

Novelty Jig-Sawing

• WHAT CAN YOU MAKE WITH *Picture Puzzle Tools*?

A NEW CONTEST

Scrolled book ends—a new idea for craftsmen who delight in making novelties

NOW that picture puzzles have made the jig saw almost as familiar a tool as a hammer or a wrench, thousands of adept amateur jig sawers are asking themselves, "What else can I make besides puzzles?"

That is a good question. The jig saw is really a most versatile little tool and it can perform wonders when skillfully used. If you doubt that, just look at the gracefully scrolled book end illustrated above. This was made by Edwin M. Love and is, of course, an exceptional piece of work, but anyone who is able to cut out a workmanlike picture puzzle can duplicate it easily enough.

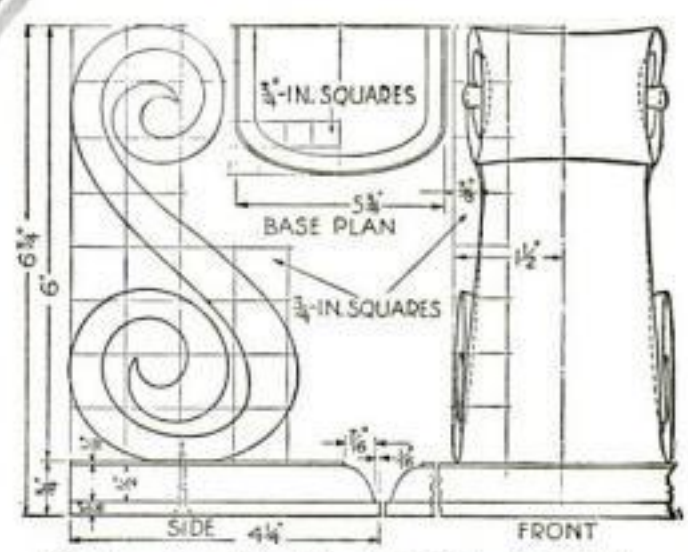
To encourage a friendly competition among readers as to who can work out the best novelties with a jig saw, POPULAR SCIENCE MONTHLY offers the following prizes:

First Prize	$25
Second Prize	15
Third Prize	5
Five Prizes $1 each	5
Total	$50

All you need do to enter this contest is to make some jig-saw project that is novel in design but not too large or complicated, and take at least two clear photographs of it. Send the prints, together with a brief description and, if necessary, a small explanatory drawing, to the Jig-Saw Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y., before April 3, 1933.

Above: Jig-sawing one of the sections, which are later glued together as shown in the oval. *At right:* A strip of wood clamped to the molding fence is a guide for shaping the base

A glued-up scroll. Much of the smoothing can be done on a sanding drum, if one is at hand

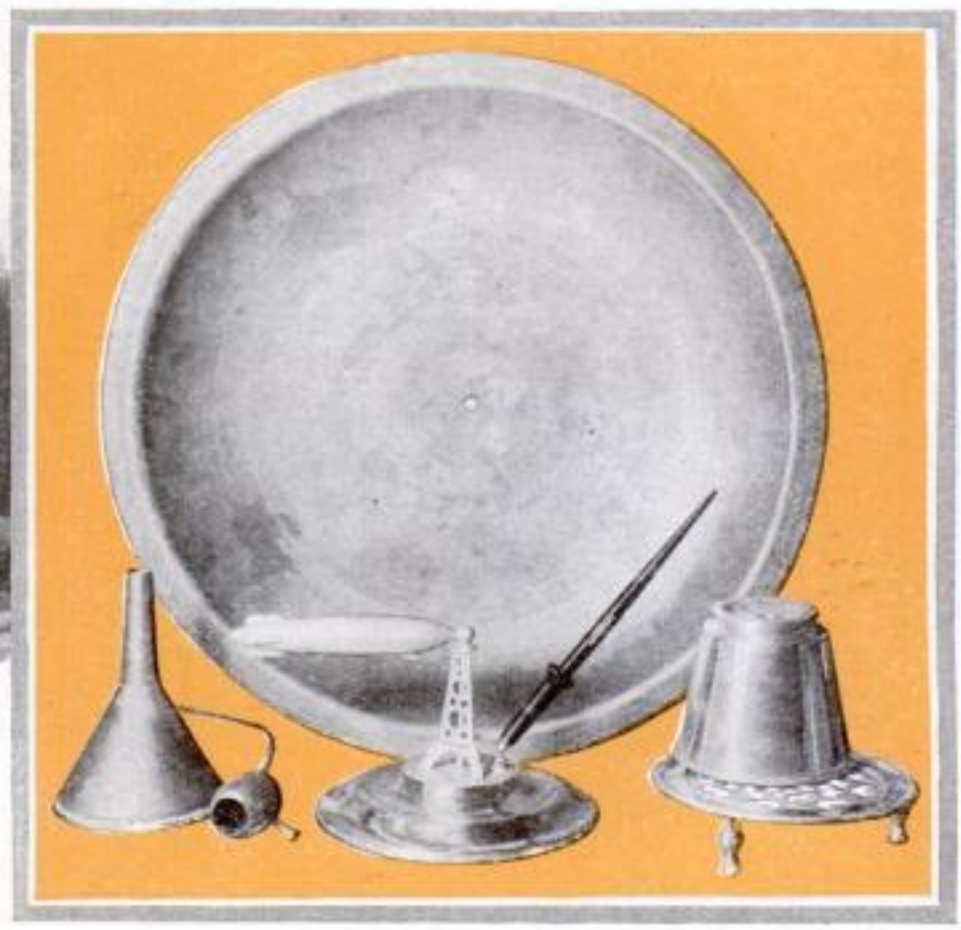


The drawings. To add weight, if desired, hollow the base and fill with melted paraffin and shot

You may use any materials you please and other tools beside a saw; however, the principal tool must be what is variously called a fret, scroll, or coping saw, or a power jig or scroll saw. The entries will be judged mainly on their novelty, but the craftsmanship and simplicity will also be considered. Old-fashioned, intricate fretwork is not desired so much as new ideas for utilizing a jig saw. In the case of ties, each tying contestant will be awarded the prize tied for.

There's No Mystery

Frank J. Stolitzka, a master metal spinner, shows how the spinning tool is held. *At right:* Examples of his work



By HERBERT WOOLSEY

TO THE amateur mechanic and to a great many professionals as well, the spinning of metal is a mysterious process in which the spinner converts flat pieces of sheet metal into all kinds of intricate shapes. There need be no mystery about spinning, for it is a field which lies within the reach of any mechanic if he has access to a suitable lathe.

If you are not sure just what spinning is, look about you for some examples. Perhaps the coffee percolator on your kitchen stove was made on a lathe. The pie and cake pans may claim the same origin, although it is equally likely that they were stamped out on a press. Parts of light fixtures, metal water and cream pitchers which have bulging sides, automobile headlight casings and reflectors, one-piece aluminum funnels—all such objects can be produced by the metal spinner.

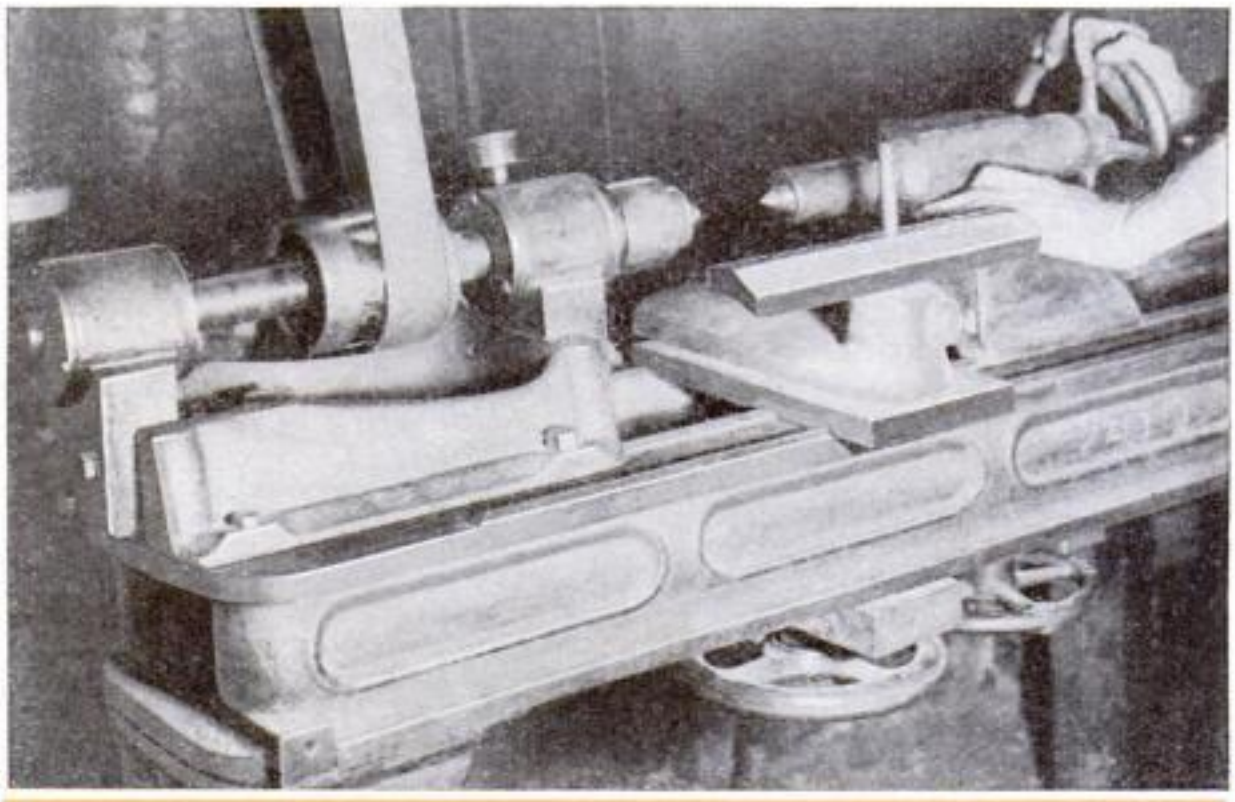
Professional spinners use a lathe that is built specially for the work. It differs from other lathes principally in the bearings in which the spindle rotates. These are heavy and built to take end thrusts. Frank J. Stolitzka, of Akron, Ohio, a master spinner of more than forty years' experience, uses a homemade lathe made by installing, on an old machine lathe bed, a set of heavy roller bearings packed in grease. There are two rings of rollers in each bearing. The nose of the spindle is threaded like that on any engine lathe. The tailstock is of conventional construction, but has a special center. The tool rest also is designed for spinning requirements. This lathe is the one seen in nearly all the photographs illustrating this article.

You can spin on any ordinary metal turning lathe, but you will have to be careful. The high speed of the spindle—from about 800 to 1,200 R.P.M. for some work—combined with the heavy pressure of the tool, may cause bearing trouble. Perhaps by installing a roller or ball thrust bearing, against which an intermediate chuck presses, you can relieve the strain on the main bearings to some extent.

Many wood turning lathes are more adaptable to spinning than machine lathes. For example, one type has a four-step V-belt pulley rotating against a ball thrust bearing. Such a lathe, with a good supply of power and a few minor changes that in no way affect its usefulness for woodworking, makes an excellent small spinning machine.

The spinner's tool rest looks like an unusually heavy T-rest of the type familiar to woodworkers. Along its top surface is a row of holes into which a steel peg, measuring about ⅜ in. in diameter, can be inserted. This peg is a little larger than the holes, and has one end turned smaller to form a shoulder that prevents it from dropping down too far. In use, the peg forms a fulcrum or rest against which the tool bears, enabling the operator to apply great pressure against the work.

It is absolutely necessary, for successful spinning, to have a rotating tailstock or back center. There are on the market various types which, in general, consist of a hollow steel cylinder in which a steel shaft rotates against radial and thrust



Homemade spinning lathe built on an old engine lathe bed. Note the heavy ball bearings and the special tailstock or back center. Suitable parts often can be found in junk yards

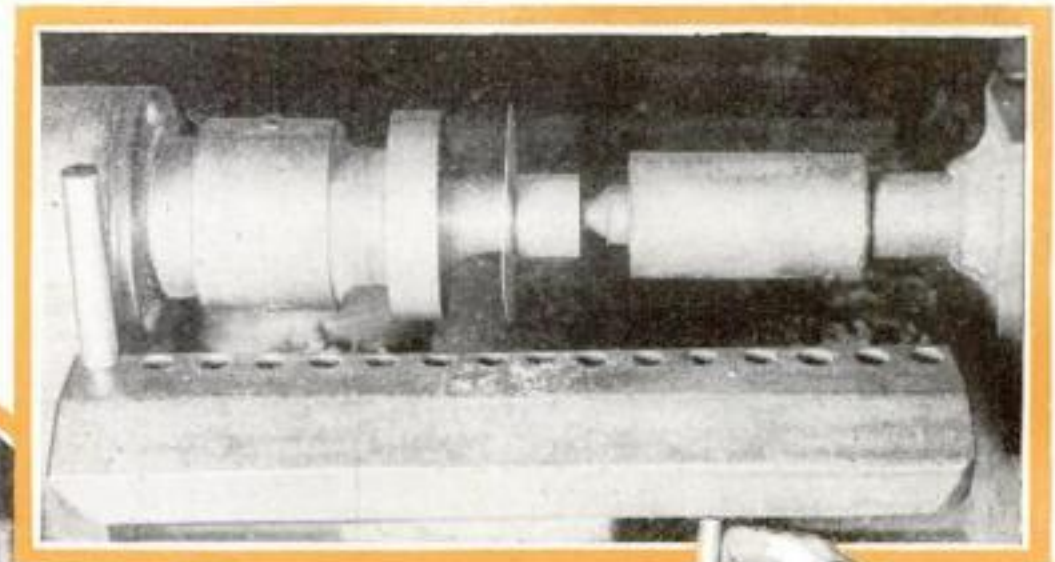
About Metal Spinning

If you have a lathe, you can learn the art easily and make many decorative objects from sheet copper, aluminum, and other metals

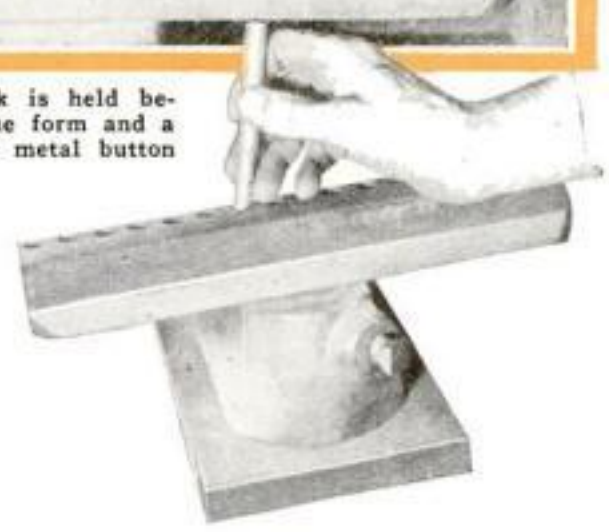
ball bearings. The outer end of the rotating shaft is turned to an angle of about 60 deg., and the end of the casing opposite the point is equipped with a taper shank that fits the lathe tailstock. However, the wood lathe previously mentioned, which is shown below, was fitted out with a rotating center simply by slipping a small ball thrust bearing over the ½-in. tailstock shaft, removing the set screw from the tailstock center supplied with the lathe, and placing this center over the shaft so that its end rests against the bearing. The cost of the bearing was 25 cents. As for the tool rest, it was made by fastening a steel bar to the end of a short section of ½-in. shafting, and drilling a row of holes for the peg.

In the stamping of objects on a press, hardened steel dies are used. Likewise, in spinning, steel or wood forms are employed. But the cost of such forms, which need not be hardened, is but a fraction of the cost of corresponding dies, which makes spinning frequently preferable to stamping, particularly where small lots are being made. And, of course, many things can be made by spinning that could not be produced on a press.

The spinning form, chuck, former, or whatever you prefer to call it, is attached to the rotating lathe spindle. Next to it is placed the metal blank to be spun; then a metal or wood button or adapter *(Continued on page 88)*

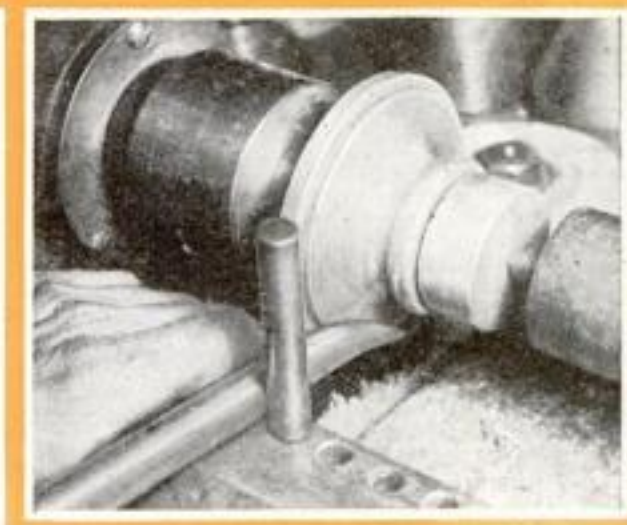


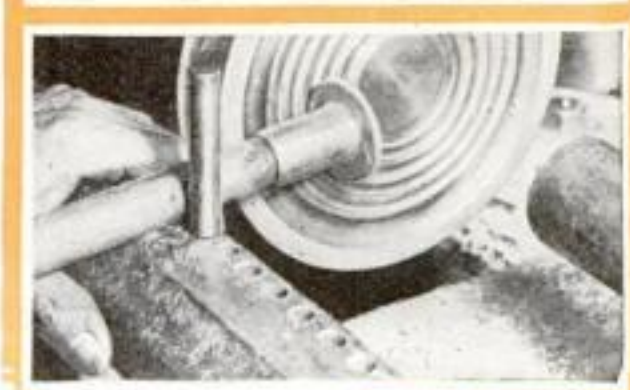
The disk is held between the form and a wood or metal button

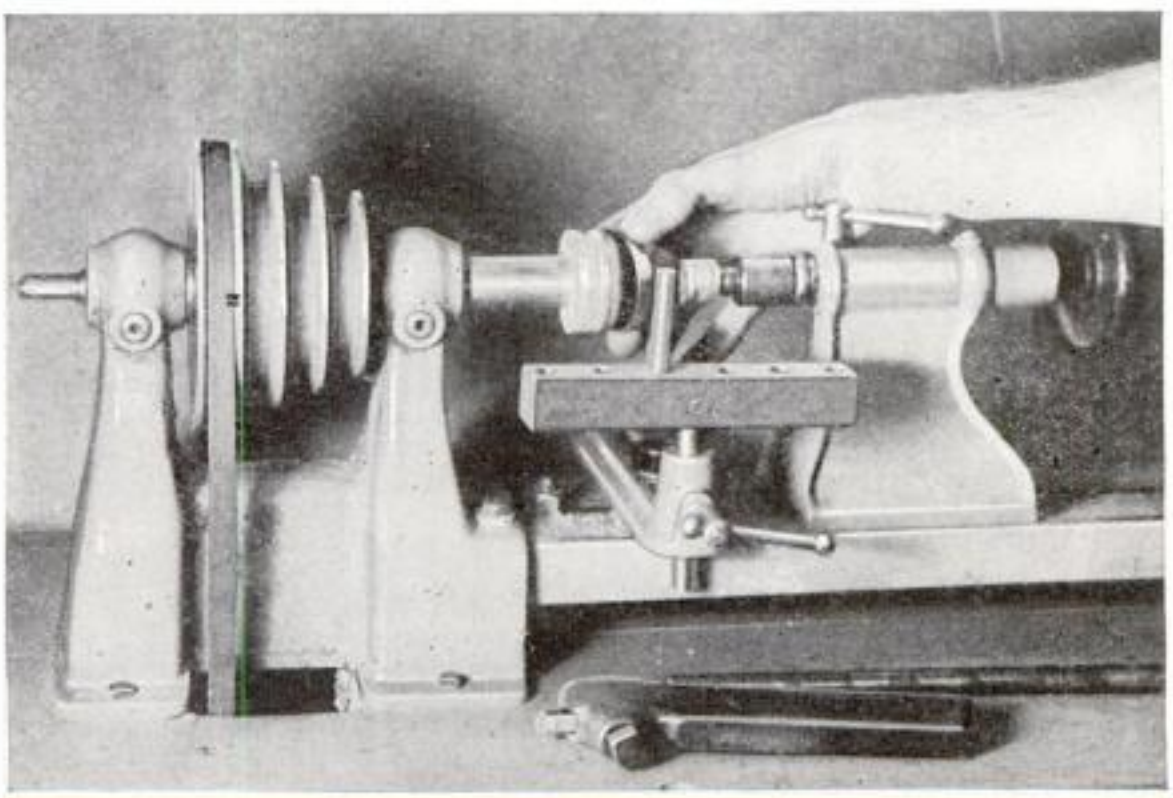


The T-rest has a series of holes in which a heavy steel peg can be inserted to serve as a fulcrum for applying pressure with the tool

Above: Applying lard to a disk with a cloth dauber. The three illustrations at the right show, first, the use of a pointed tool, the point being at one side; second, rolling an edge with a tool made from a grooved pulley wheel; third, another wheeled tool for making grooves







Excellent spinning can be done on a wood turning lathe. The wooden form is mounted on a threaded stud, and the tailstock center revolves against a ball thrust bearing

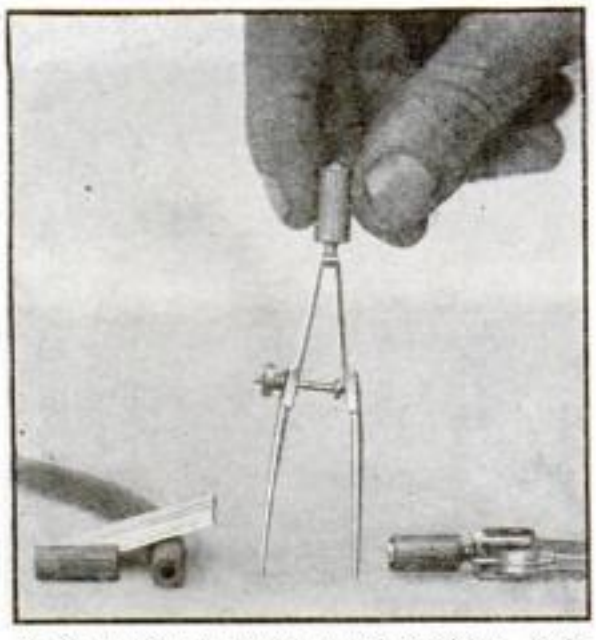
MAKING AN ALARM CLOCK SHUT ITSELF OFF

IF AN alarm clock is placed within reach, it startles us and gives us a more or less severe psychological shock when it goes off, yet if it is too far away from the bed, we have to get up to turn it off. Here is a simple method of overcoming this problem, provided one is in the habit of awaking at the first ring and will not merely turn over and go to sleep again.

A metal clip is made to slip over the winding handle of the alarm in such a way that it will come to a stop against the hand-set knob or the alarm-set knob when the alarm handle turns while the alarm is ringing. The alarm handle then has to be wound only half a turn to set the alarm, and it is never necessary to turn off the alarm with the regular lever. This improvement was made in the case of the clock illustrated above merely by placing one of the new flat hairpins on the alarm handle.—ALTON BIRMEM.

RUBBER GRIPS IMPROVE DRAFTING TOOLS

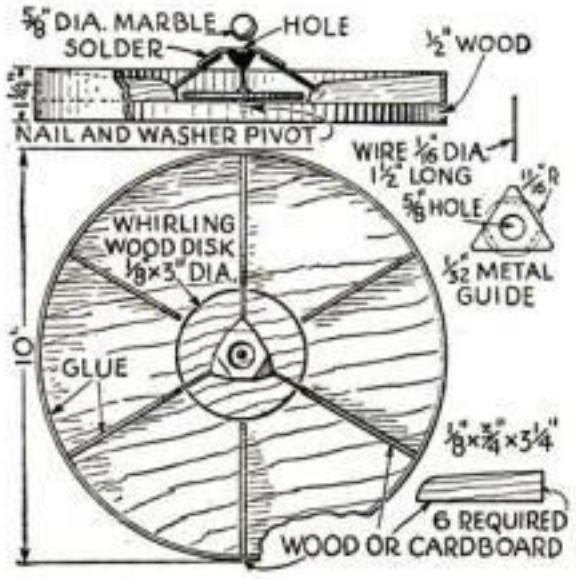
THE handles or finger grips of many small drafting instruments are tiresome to use, especially on long, tedious jobs. An improvement is to slip short lengths of pneumatic windshield wiper tubing over the finger grips. The inside of the tubing is the right size for most small instruments, and the outside, being soft and finely ribbed, gives an ideal grip.—F.B.



It is easier to hold small drafting tools if rubber tubing is slipped over the handles

WHIRLING DISK MARBLE GAME

BECAUSE of the present popularity of marble games, many home workers are looking for new and simple variations of standard designs that can be constructed easily and inexpensively. A design of this type—a little game called "disk-o-luck"—is suggested in the accompanying drawings, which give all the necessary information as to its construction. The board should be attractively painted in bright colors, preferably enamel or lacquer.

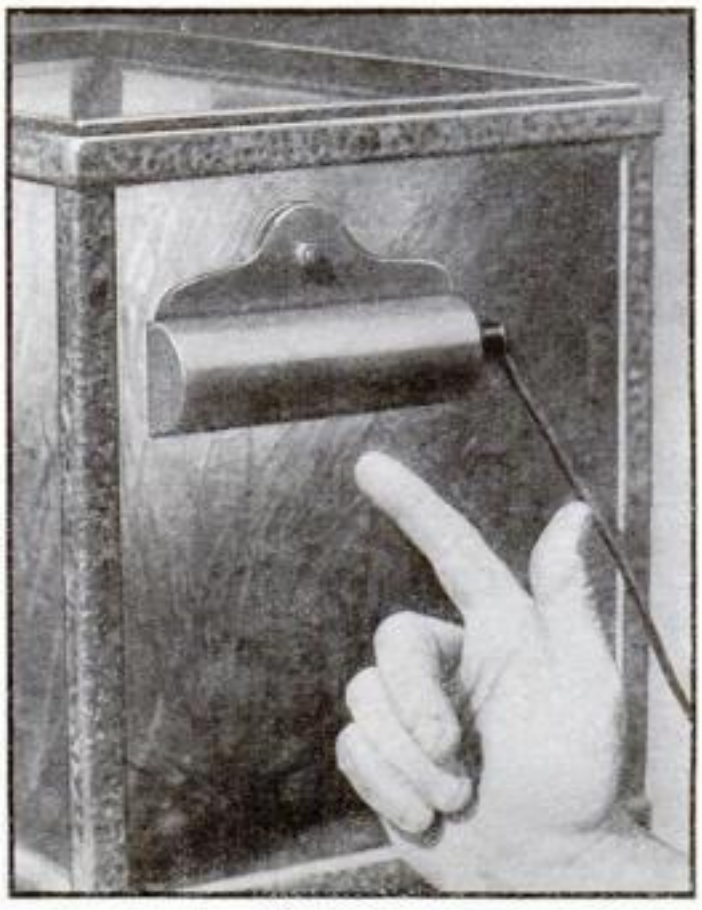


A top view and a side or edge view, partly broken away to show the disk and guide plate

The small disk in the center is spun so as to shoot the marble into one of the six compartments

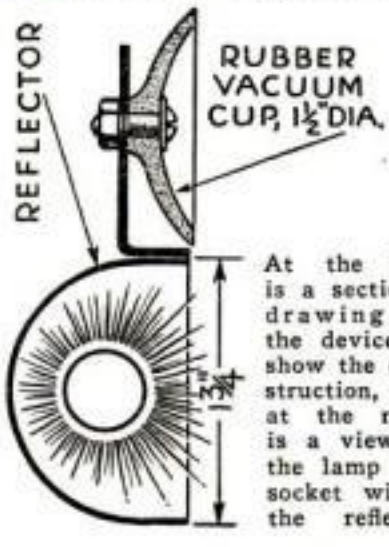
To play the game, the disk is spun with one finger and the marble is dropped through the hole in the guide plate. The whirling action of the disk rolls the marble into one of the pockets. The goal is a score of 200. Any number of players can join in the game.—DONALD W. CLARK.

HOW TO FLOOD-LIGHT YOUR AQUARIUM



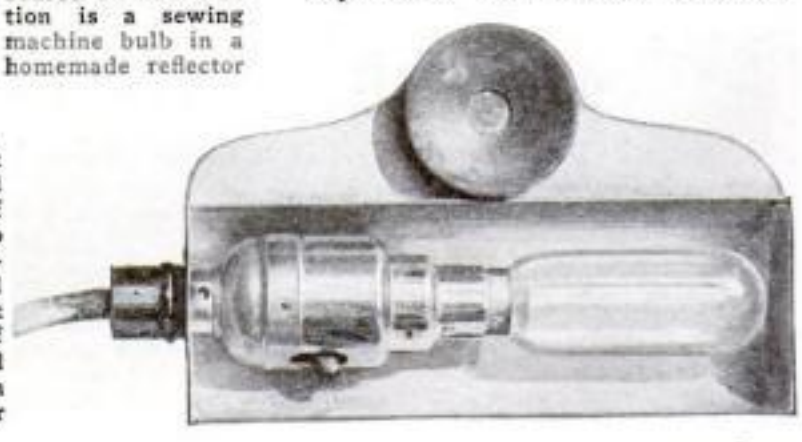
TROPICAL toy fish are even more beautiful under artificial light than in daylight. The flood light shown is small enough not to interfere with the vision, simple and inexpensive to make, and, most important of all, may be attached wherever necessary. It may even be applied to the cover glass of round, bowl-shaped, and globe type aquariums. A sewing machine light and socket are perfectly adapted for the average home aquarium. For large aquariums, tubular display lamps (with intermediate base), either single or in multiple, will give any effect desired. Sufficient extra vacuum cups should be added, of course, to sustain the weight.

The reflector of the lamp illustrated is made of tin and is 5 in. long and approximately 1¼ in. in diameter. The rubber vacuum cups, with a small bolt and nut attached, may be obtained from dealers in rubber goods. By means of bronze powder and a few drops of bronzing liquid, the outside may be finished to harmonize with any aquarium.—R. GERALD BULLARD.



A vacuum cup keeps this aquarium light in position. The source of illumination is a sewing machine bulb in a homemade reflector

At the left is a sectional drawing of the device to show the construction, and at the right is a view of the lamp and socket within the reflector



Working Toy Derrick Built for Few Cents from Odds and Ends

BECAUSE it really works, the derrick illustrated is a completely satisfying toy for any small boy. It is large and substantial, yet the construction is simple and the materials, for the most part, are odds and ends of wood, wire, and tin that can be picked up in any home workshop.

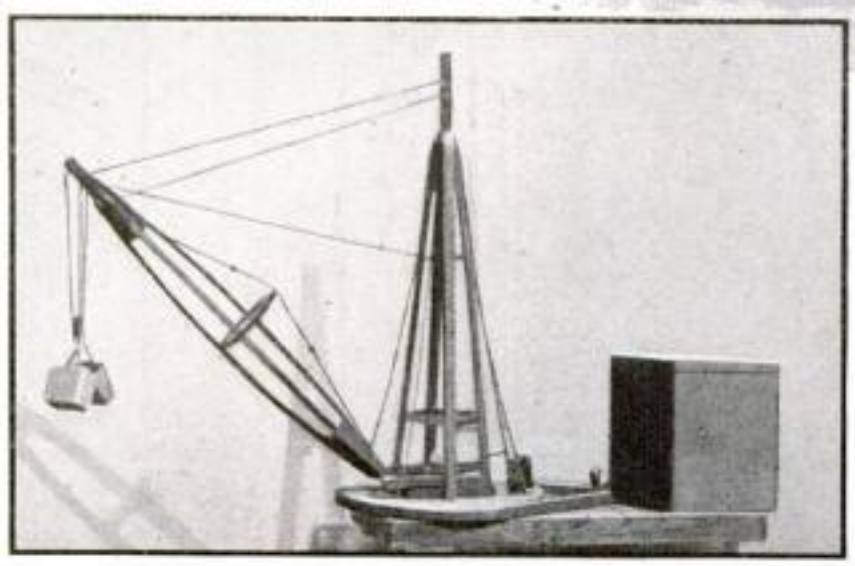
The base should be about 12 by 28 in., made from ¾-in. boards cleated together. Fit casters in the four corners, or use small wheels from discarded toys. A turntable about 14 in. in diameter is mounted at one end of the base with a bolt. In the original model this turntable was made from the top of an old flower stand. If nothing like that is available, saw the disk from a wide board.

On the baseboard about 6 in. back from the edge of turntable, fasten a small spool which has been wound with tape and fitted with a handle. A belt extends around turntable and spool; it can be made from a couple of old fan belts or from heavy canvas.

Next, the tower is built on the turntable. Almost any kind of wood may be used. The parts are so well braced that soft wood will serve the purpose adequately, and it has the advantage of being easier to work with than hard wood. The uprights are ⅜ by ¾ by 25 in. and are screwed to cleats at the bottom. The top section, ¾ by ¾ by 10 in., is slotted to receive two sheaves or pulley wheels. Wedge-shaped pieces are fitted on the four sides, and to these pieces the uprights are screwed as shown at *A* in the drawings at the bottom of the third column. Braces are fitted between the uprights as indicated in the photographs.

In building the boom, which is shown at *B*, make the end sections first. These are ¾ by ¾ by 7 in. with wedge-shaped pieces fastened to them to receive the ends of the ribs. Cut a slot in the upper end section and fit in a small pulley wheel. The ribs are ⅜ by ½ by 28 in. Secure these to the end sections, and at the center insert a spreader made of ½-in. wood, 2 in. square, with the corners cut off as in detail *C*.

To give wider bearing for the boom at the bottom, it is best to screw to each side rib a piece of wood ½ by ¾ by 12 in., beveled off to fit the angle of the rib, as shown in the drawings. These two arms and the end of the boom itself should be drilled to receive a stiff piece of wire. Screw two blocks to the turntable at the base of the tower to carry the ends of this wire, forming the bearing for the boom. Brace the boom with wire to give greater rigidity.



With this toy derrick, a boy can go through all the motions of a stationary engineer. Operating one winch lifts the boom, turning another raises the bucket, and moving a spool makes the turntable revolve

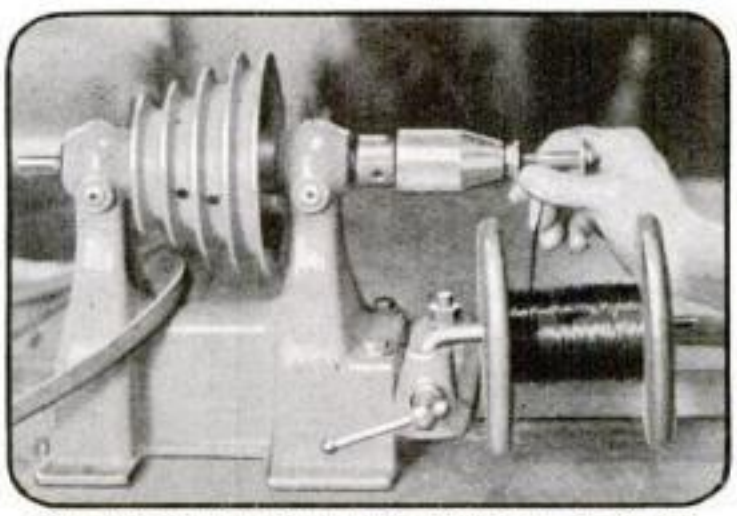
Make the bucket from two pieces of heavy tin cut out and bent as at *D*. Put them together with piece of stiff wire.

Lifting the boom and the bucket is done by two small windlasses made of heavy tin or other sheet metal and heavy wire, as shown at *E*. The shaft or crank should fit loosely enough to slide sideways and engage the stop.

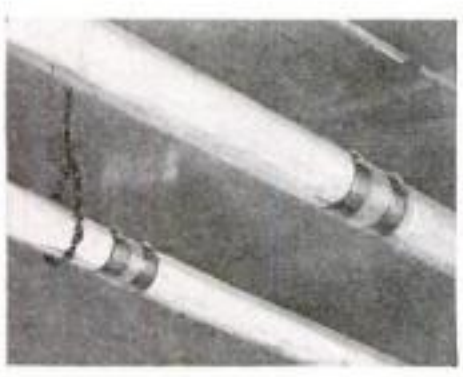
In the original model the bucket was interchangeable with an electromagnet, power for which was supplied from an old automobile battery incased in a box behind the derrick.—F. J. SIEFKE.

WINDING SMALL COILS ON A LATHE

IN WINDING coils, magnet bobbins, or small armatures on the lathe, the spool of wire can be conveniently held by mounting it on an L-shaped rod set in the tool post as illustrated at the right. The bobbin then can be gripped in the lathe drill chuck and rotated either by hand or with the motor drive, whichever is the more convenient and practical for the special work in hand.—R. W.

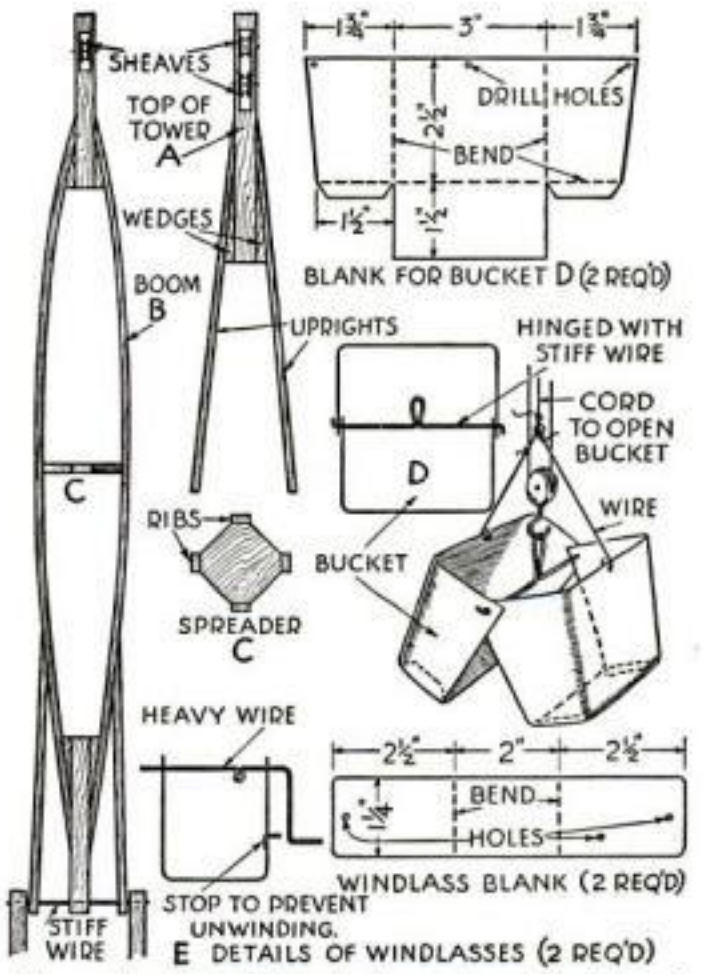


The spool is placed on an L-shaped rod set in the tool post, and the bobbin is gripped in a drill chuck



INSULATED PIPE JOINTS

TIN cans can be used to repair sections of asbestos pipe covering which are coming apart. Both the tops and the bottoms are removed, and a length-wise cut is made from top to bottom. Thus prepared, the cans are placed over the asbestos covering where the joints have separated, and regular pipe covering bands clamp them on.—V. ESPER.



Suggestions for making the boom, tower, bucket, and windlasses, and patterns for cutting the tin parts

Knotted Silk Pulls *for*

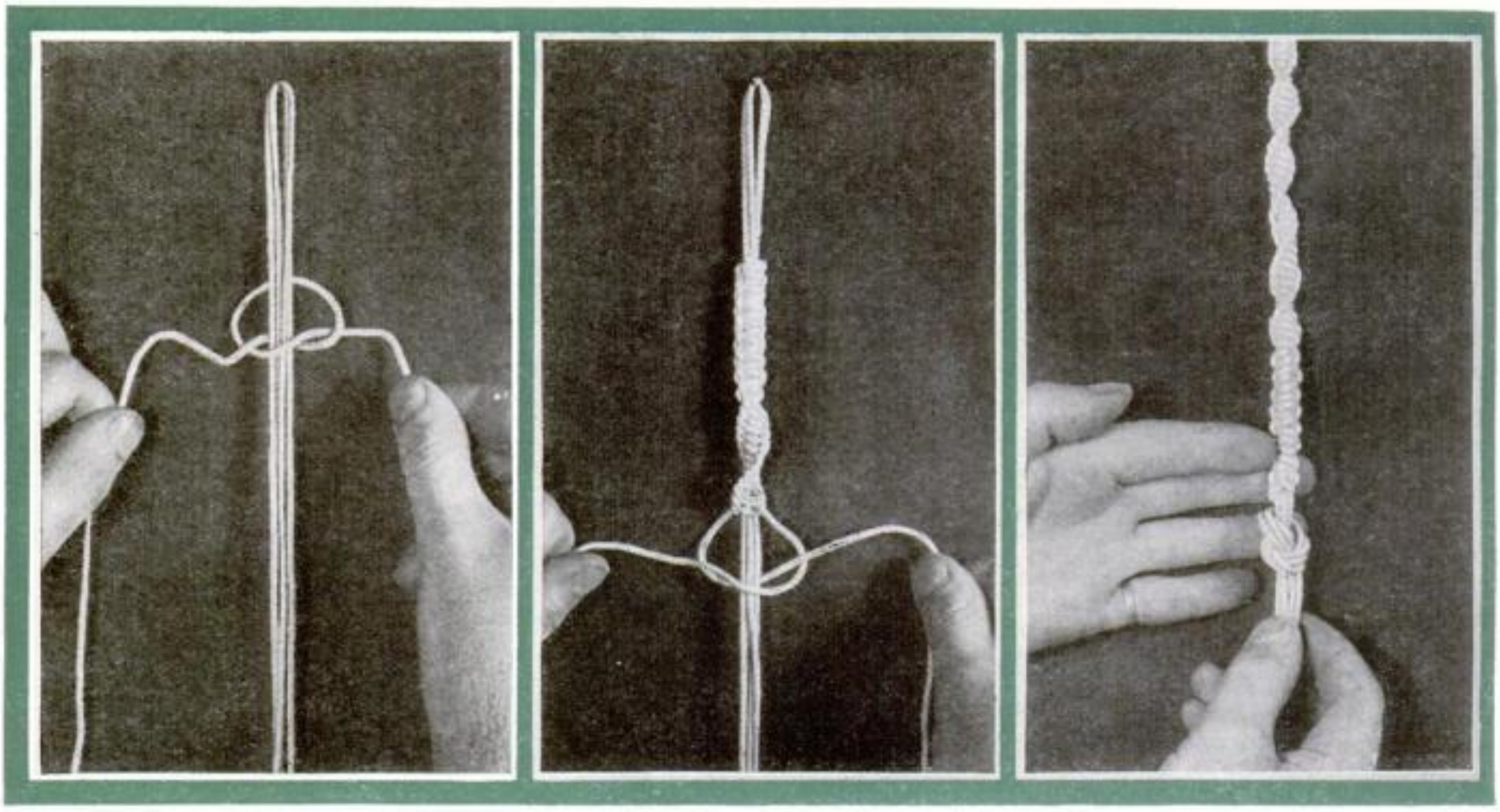
By Kenneth Murray

ORNAMENTAL square-knot pulls for window shades or floor lamps can be made in a variety of designs from medium or heavy silk cable cord. The length, size, color, and quality of cord can be chosen to suit individual preference.

This project is similar in character to the

An ornamental and durable pull for a floor lamp made by knotting together three lengths of heavy silk cable cord. The knots are of the same type as those used for tying packages. *At right:* A larger view of the complete pull and its tassel

The filler cords are held taut by catching them on a wire hook fastened at one's chest or waist



1 The filler cords are doubled and placed over a nail, and the other ends are tied to the knotter's hook. The knotting cord is then tied around several inches below the nail

2 After the straight square-knot section has been carried to sufficient length, a series of half hitches are tied, and the pull naturally assumes a twisted or spiral shape

3 Another square-knot section is added; then the cords are knotted together to make a hard ball. This forms the base for the tassel, which is added separately

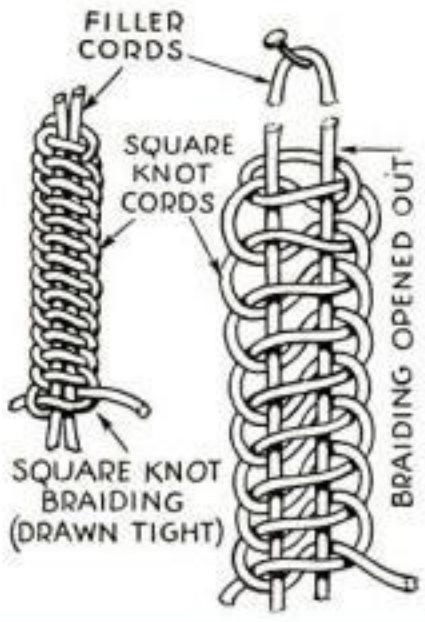
Window Shades and Floor Lamps

knotted belt described in a previous article (P.S.M., Nov. '32, p. 77) and is presented in response to hundreds of requests from readers for more designs for square-knot work.

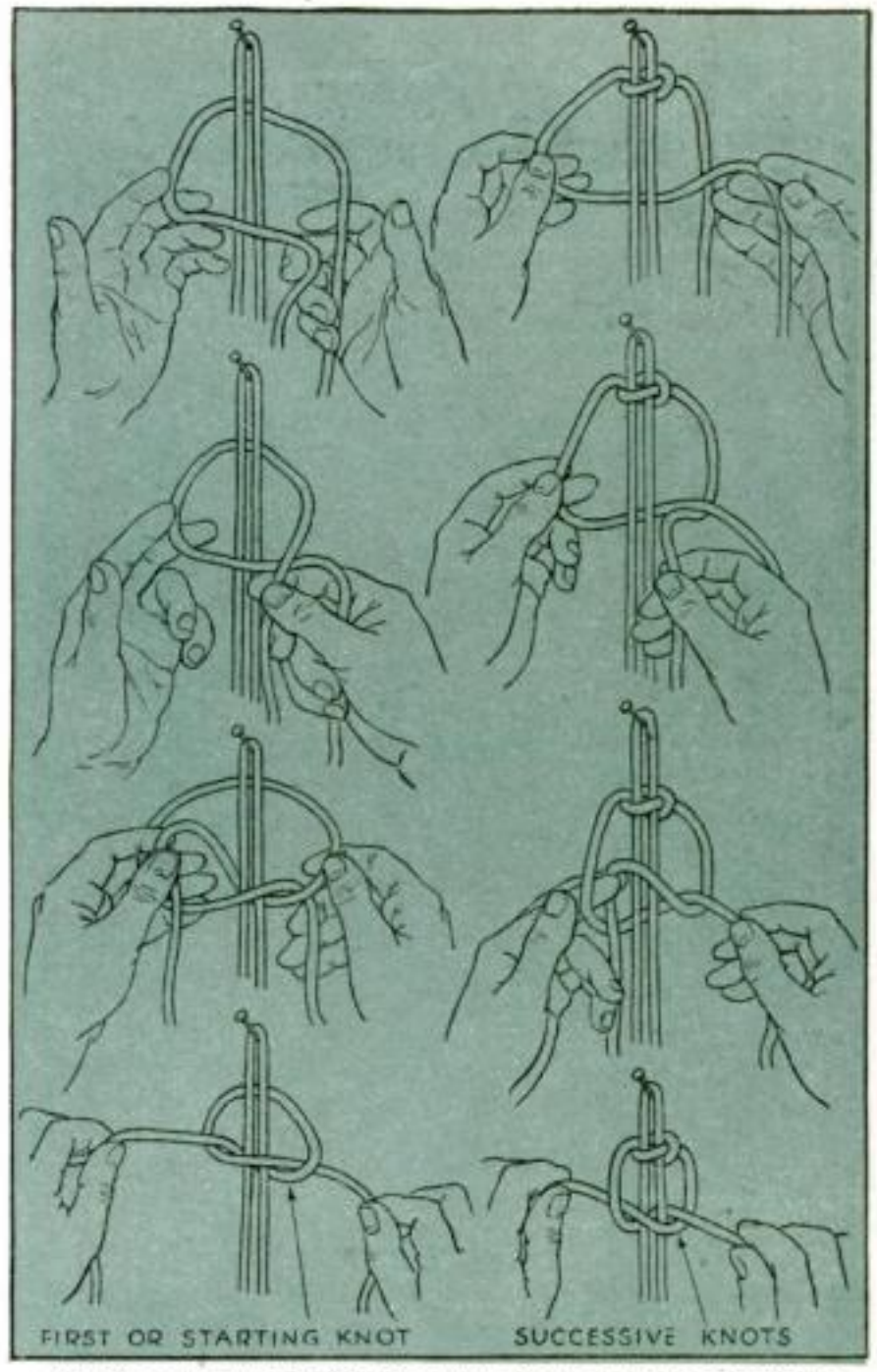
The only equipment required is a hook to hold the loose ends of the cords while the knotting is in progress. This can be a heavy wire hook (or bent nail) set into a piece of wood about ½ by 1 by 3½ in., as shown in one of the photographs, or a small notched stick of wood such as was illustrated in the previous article. In either case it is fastened to your chest.

For the filler use two lengths of cord, each 2 yd. or more in length. Double these and hang them over a nail as shown. Make the ends fast to the hook on your chest so that the cords will be held taut, as shown in the circle on the opposite page.

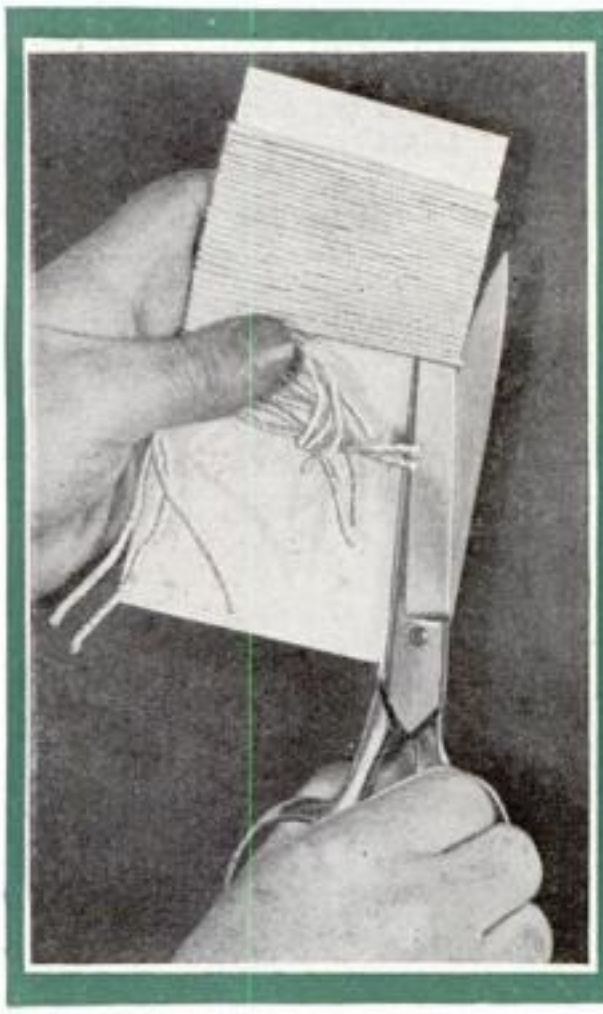
The knotting cord is 3 yd. long. Tie the center of it with a square knot to the filler cords several inches down from the nail. Then, to make a pull exactly like the one illustrated in the photographs, continue with nine more square knots. Next run a series of about thirty-five half hitches to give a spiral design. Add ten more complete square knots, and finally knot all the cords into a small ball.



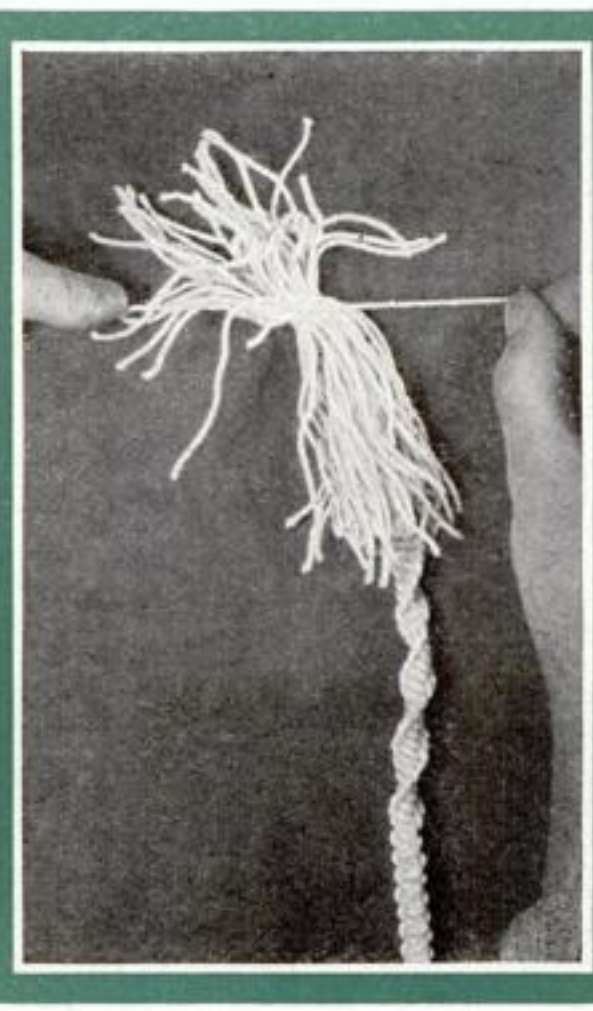
To make the tassel, cut twenty-five or thirty pieces of cord 6 in. long, group them about the ball, and tie another cord securely about the end of the pull, above the ball. Draw the tassel cords down over the ball and tie them immediately beneath with several turns of the same cord. Trim the ends evenly.



The diagrams in the left-hand column above show the actual steps in tying the first knot around the filler cords. For clearness, only one filler cord has been indicated. The other column shows how second half of knot is tied. *At left:* A series of knots



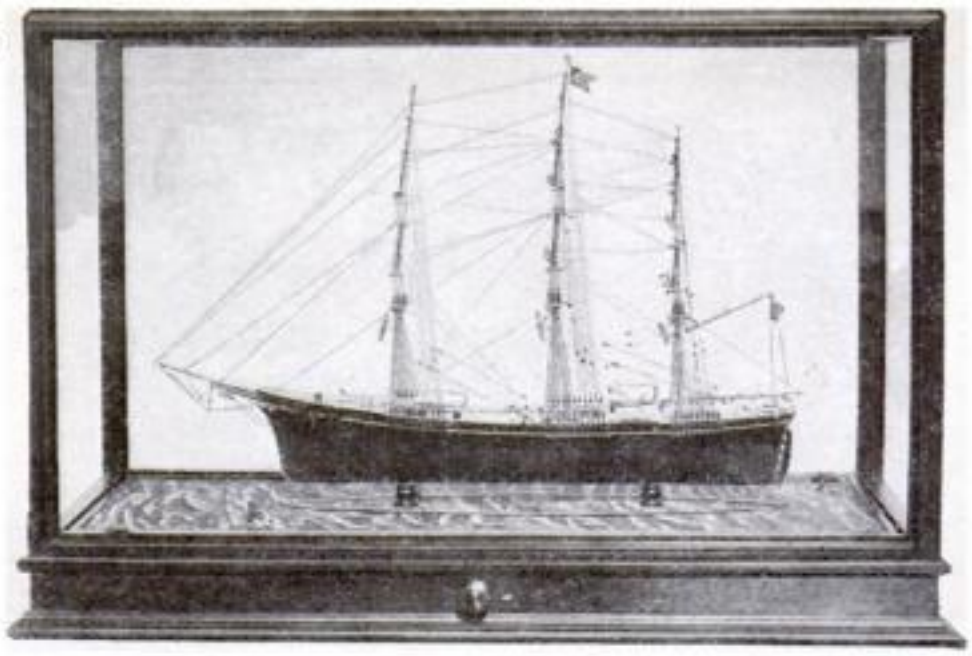
4 The tassel is made of twenty-five or thirty pieces of cord 6 in. long. The quickest way to cut these is by wrapping the cord around a piece of cardboard 3 in. wide



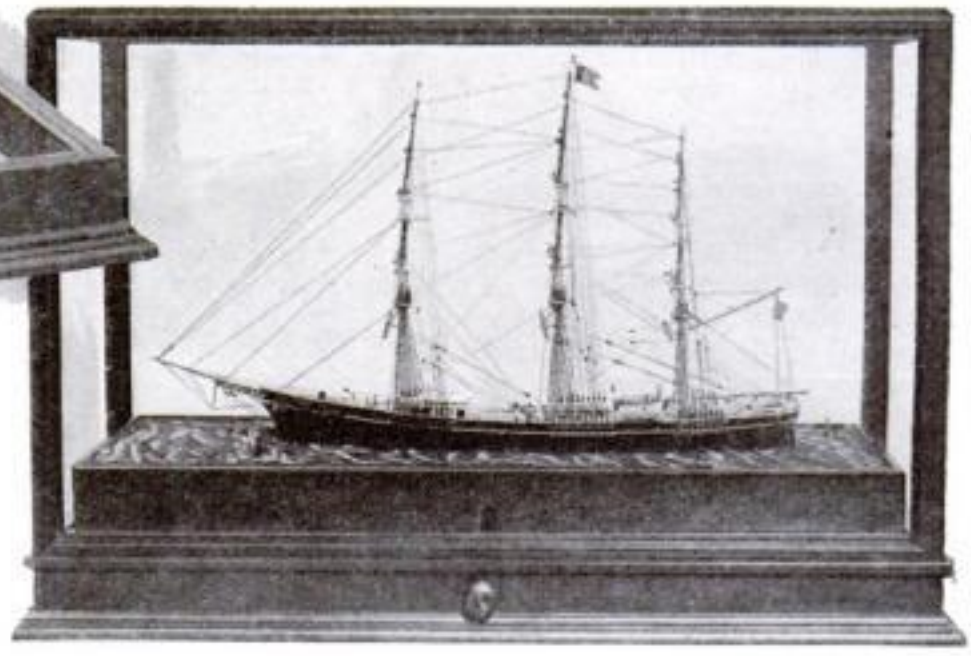
5 The first operation in making the tassel is to group the cords about the ball and extending along the pull. Another cord is then used to fasten them just above the ball

6 The tassel cords which extend along the pull are next turned down over the ball, and all the cords are tied beneath the ball with a few turns. Then the ends are trimmed

"WATER" IN SHIP MODEL CASE LOWERS TO REVEAL HULL



Prize winning model of the clipper ship *Sovereign of the Seas* mounted so that the whole of the beautifully modeled hull can be seen. *Below:* The case with "water" raised to the water line



Turning the central knob causes two sets of wooden cams to revolve, and these move up and down a light platform upon which the imitation water is fastened

In general appearance the ship model case illustrated is not unlike others, but by turning a knob "water" rises around the hull until the ship seems to float at anchor. This effect is achieved by raising a light wooden platform, with a hole in it the shape of the model's water line. The hole is undercut to aid in centering the platform in its lower position, where it rests flush with the stationary mounting that supports the model.

Make the imitation water by soaking linen in thin glue and modeling it in place while still wet. Color it with water color paints and touch up the wave crests with white enamel. Shellac the interior of the platform to prevent warping.

The device that elevates the platform consists of two sets of wooden cams—pieces with curved outlines—set near the end of the platform. To reduce friction, the edges of the cams are V-shaped and slide on strips of tin on the underside of the platform. The cams are operated from the center shaft with the hand knob by means of heavy cords rubbed in resin. Each cord runs continuously from one shaft to the next, making about four turns around each. The end shafts should be about twice as large in diameter as the center shaft.

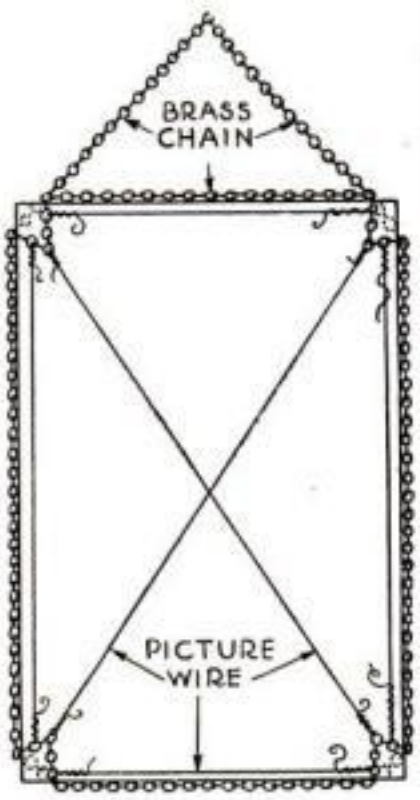
All the materials may be purchased for not more than five dollars, and the resulting case is exceptionally effective. The model in the case illustrated is the clipper ship *Sovereign of the Seas*. It won first prize at a recent exhibition in Detroit.—John A. Williams.

BRASS CHAINS MODERNIZE OLD MIRROR

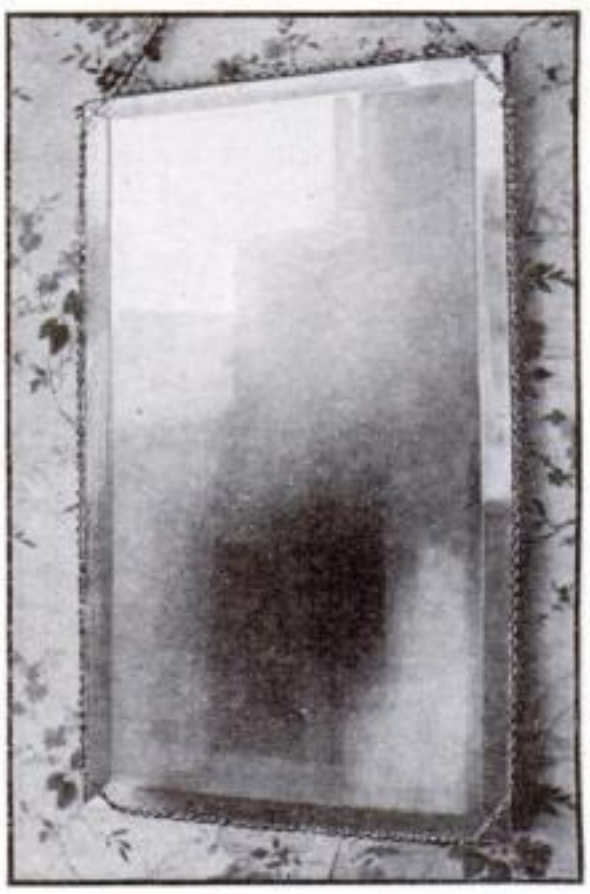
For an expenditure of not more than 40 cents it is possible to make a good-looking modern mirror frame from an old one taken from a mantelpiece, buffet, or other piece of furniture that has been discarded entirely or cut down and modernized without using the old mirror, as is now so often done. Small brass chain and picture wire, which can be bought at any hardware store, are the only materials necessary.

If the edge of the mirror is rough, it is best to have the chain extend all around as shown in the accompanying illustrations. Four short pieces of chain are attached at the corners by opening the end links of each piece, hooking them into links of the main chain, and closing them again. Another length of chain is added at the top for hanging the mirror. The corner loops are held in place over the glass with picture wire which extends from corner to corner across the back as shown.

In some cases the edges of the mirror may have been ground true and smooth and therefore do not need to be hidden by running the chain all around. It is then sufficient to use four loops of chain at the corners, fastening them behind with picture wire as shown.—Henry C. Engel.



Modernized mirror and diagram showing arrangement of chains and wire at back



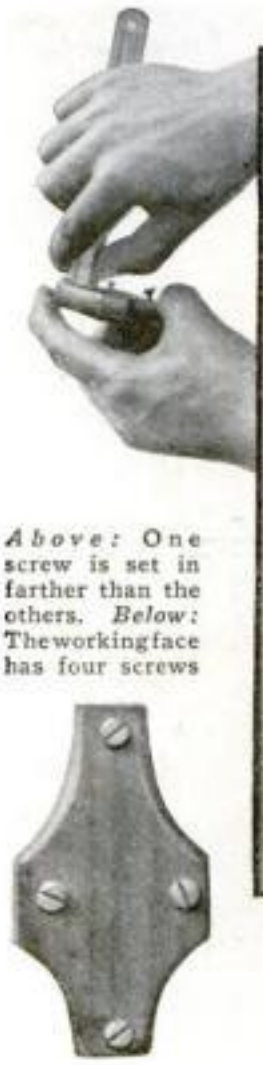
The strip to be planed is held by being glued down at one end to a much heavier piece

HOW TO HOLD VERY THIN STRIPS FOR PLANING

VERY thin strips of wood are often required, especially for building models, but it is difficult to hold them so they can be planed without breaking. Recently I needed some strips less than 1/16 in. thick. I first dressed a block stiff enough so that it would not bend under the plane and then glued about 1 in. of one end of the strip to it with thin paper between, and with the grain running the right way from the glued end. The planing was done away from this end.—JOHN TREWEEK.

GAGE AIDS IN SETTING CIRCULAR SAWS

THIS gage for testing and adjusting the set of the teeth of small circular saws can be made in five minutes. All that is needed is a block of hardwood about ¾ in. thick, 1¼ in. wide at the center, and 2½ in. long, and also four small flathead screws ½ or ⅜ in. long. One face of the block is kept flat, but the other side is tapered toward both ends, and for convenience the block is formed roughly to the shape shown in the small photograph at the right. The two screws at the center and the lower screw in the photograph just mentioned are adjusted so all have a true bearing surface on the face of the saw. The remaining screw at the upper point is screwed in an amount equal to the desired "set" of the saw teeth. The more set, the farther in this screw is driven, and vice versa. It can be adjusted very accurately.



Above: One screw is set in farther than the others. *Below:* The working face has four screws

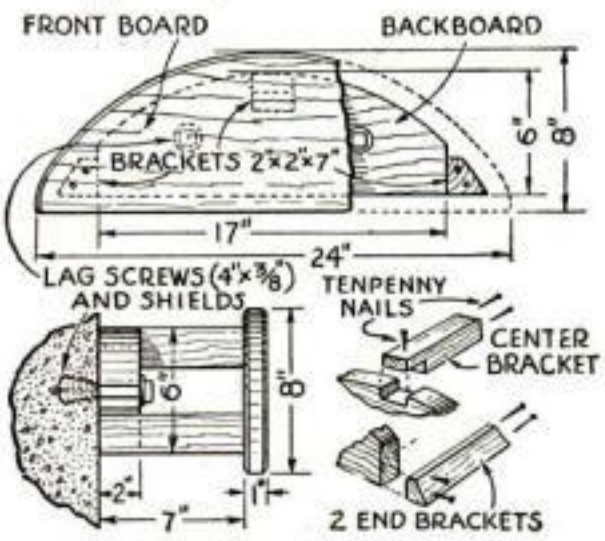
By holding the gage against the saw as above, any error in setting the teeth can be detected

In use, the gage is held against the saw as illustrated in the large photograph. It is obvious that the point of each tooth must be swaged or set sufficiently to come flush against the head of the screw that is used as the setting gage—the screw previously adjusted.—A. L. JACKSON.

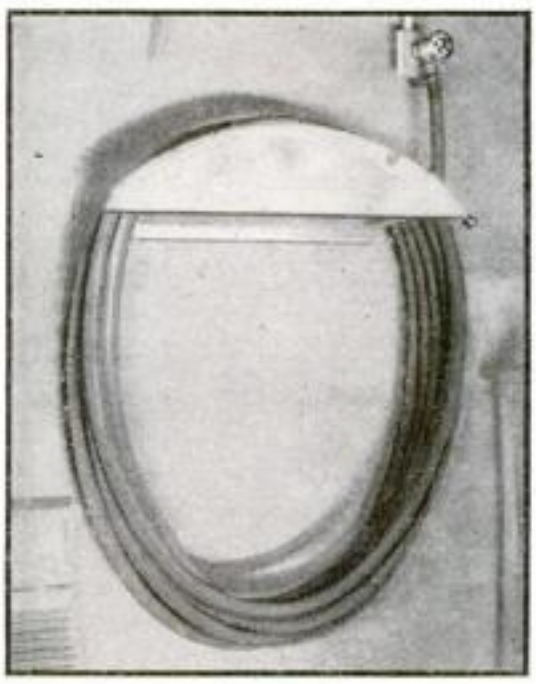
BASEMENT RACK FOR GARDEN HOSE

THE hose rack illustrated not only provides a safe storage place for the garden hose during cold weather, but also allows it to be used instantly, if necessary, for extinguishing a fire, for washing the basement floor, for filling movable tubs, or for any other purpose. A hose kept on such a rack will last for years longer than if it is carelessly handled and left lying in a kinked coil when not in use.

In most small houses the water pipes are accessible, and it is a simple matter to remove an elbow in a convenient place and insert a pipe tee and a short length of pipe with a sill cock or faucet to which the hose can be permanently connected when it is stored on the rack. The amount of pipe needed will depend on your plumbing layout, but for the rack itself the following yellow pine or other common wood is sufficient: 1 piece 2 by 6 by 17 in. for the backboard, 1 piece 1 by 8 by 24 in. for the front piece, and 3 pieces 2 by 2 by 7 in. for the end and center brackets. Tenpenny nails are used for fastening the parts together.

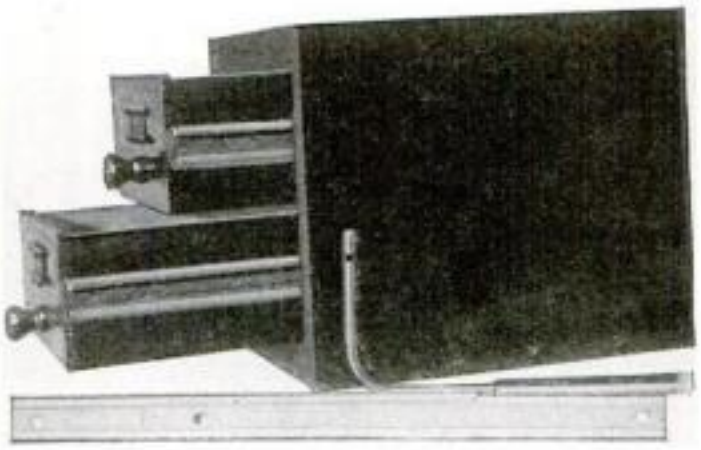


Front and end views of the hose rack and sketches showing how the brackets are nailed



Kept on this rack, the hose is always ready for instant use in an emergency

The rack can be held against the wall with 4 by ⅜ in. lag screws having expansion shields for use in masonry, or it can be fastened on 1 by 2 in. strips, which, in turn, are nailed to the floor joists above. It also might be bolted or nailed to the coal bin. The rack illustrated holds 75 ft. of hose.—WILLIAM T. WELD.



DRAWER SLIDES MADE FROM CURTAIN RODS

FLAT curtain rods of the extension type make excellent drawer slides for light drawers. They are easy to install and never bind. Dampness does not affect them, which makes them ideal for use in a basement workshop.

Rods of this type consist of two parts. The larger or outside rod is bolted or screwed with its flat side to the drawer. The smaller or inside rod is fastened on the sides of the cabinet with its flat side to the cabinet. On some rods it will be necessary to put a thin washer between the rod and the cabinet to prevent the rod from binding. This idea has many applications, and it could even be used for small sliding doors.—DANIEL REYNOLDS.

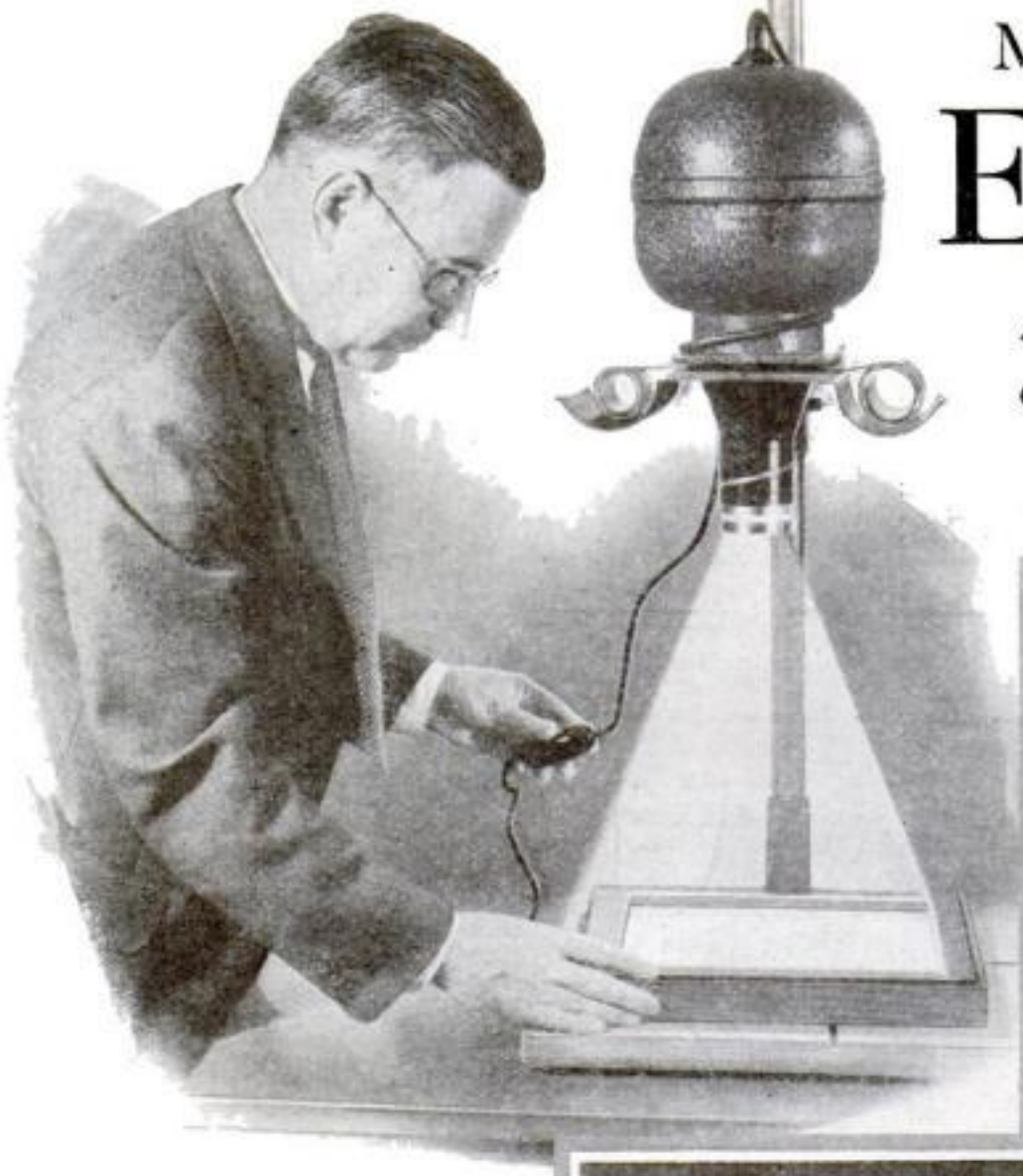
Auto Engine Contest

THE prize winners in our contest on the uses of old auto engines will be announced in the April issue.

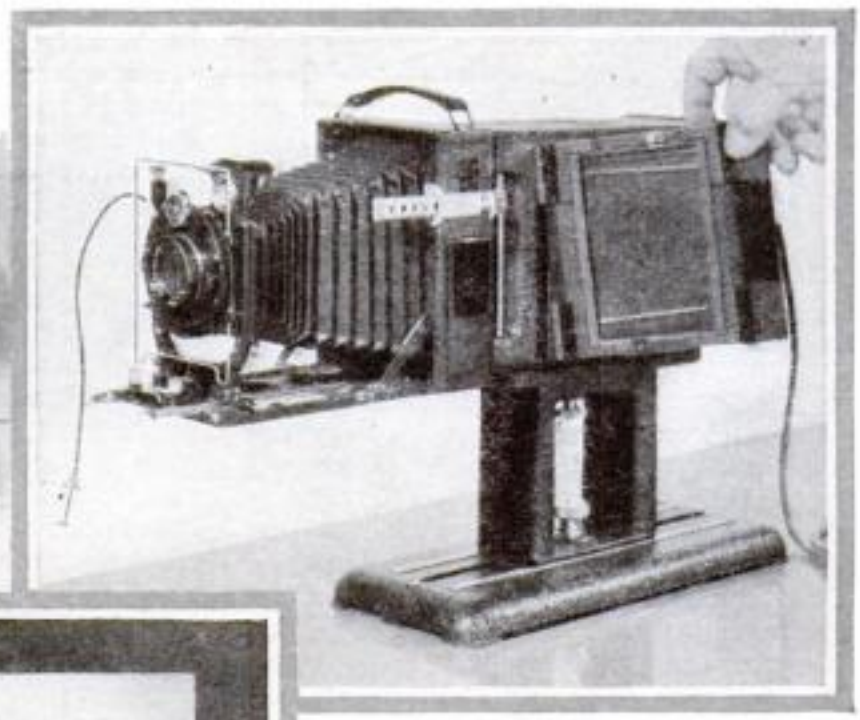
MAKING YOUR OWN
Enlargements

A fascinating branch of amateur photography

BY FREDERICK D. RYDER, JR.



Vertical enlargers, one type of which is illustrated above, are popular because of the ease with which they may be adjusted. To change the size of the picture, the light-tight housing is moved up or down

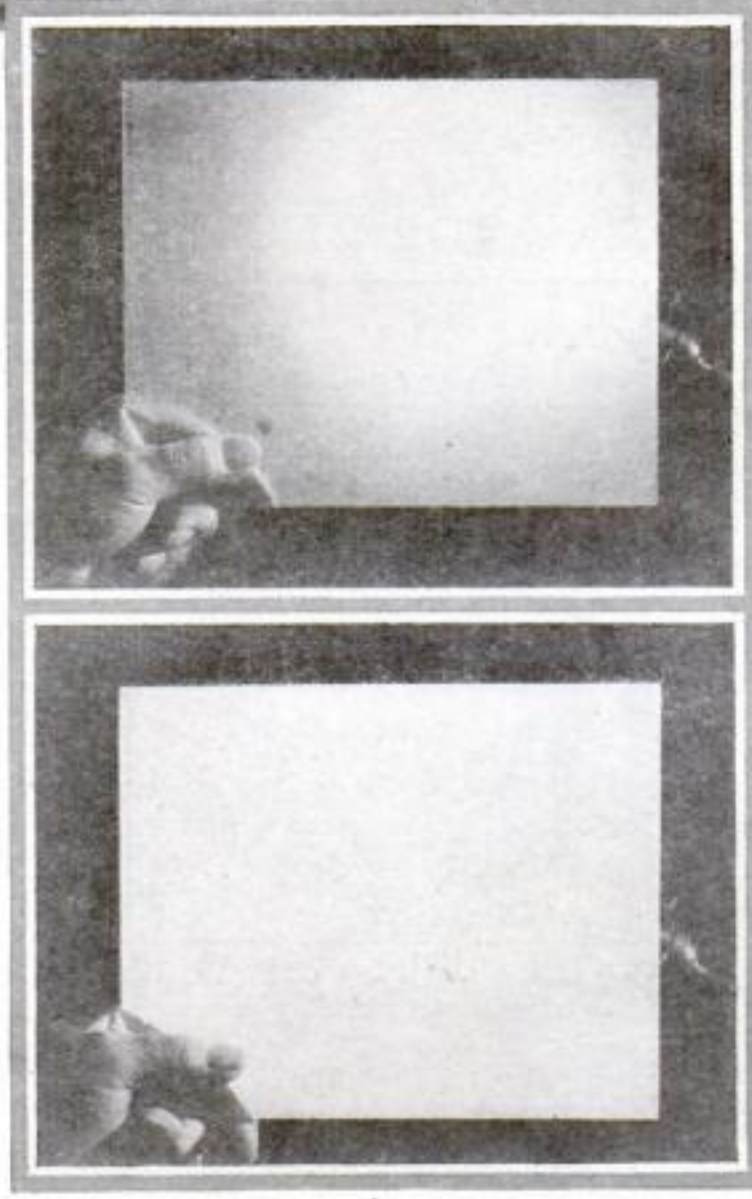


Another type of enlarging device to which an ordinary camera is clamped

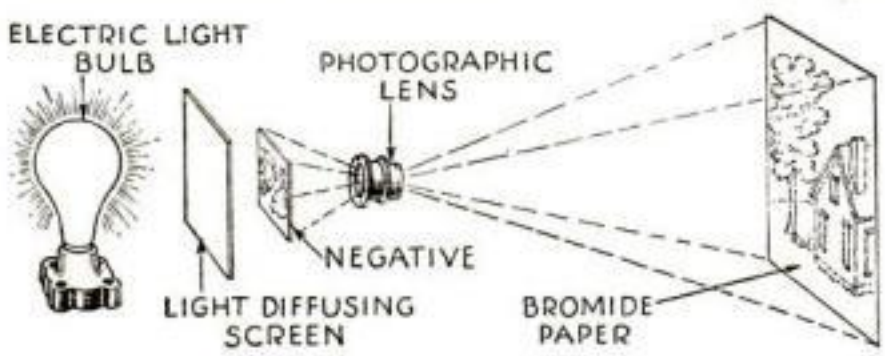
MAKING enlargements is, perhaps, the most fascinating branch of amateur photography. There always is a bit of uncertainty and the chances for a thrill in it. Delicate shadings of picture quality, which are buried deep in the tiny silver grains of the small negative and pass unnoticed in a little print, show up in striking fashion in the greater area of a large picture.

Enlarging really is picture taking in reverse. Instead of making a small negative of a big view, you are, in effect, taking a "close-up" of a small negative with a camera lens focused on a large piece of sensitive bromide paper in place of the usual glass plate or film.

The diagram below shows the optical set-up for making enlargements. Light from the electric bulb strikes the diffusing screen and loses its directional quality. It therefore floods the silver grains of the image in the negative with countless rays from many angles. The negative should appear evenly illuminated all over its surface. This is extremely important for successful work.



A sheet of ground glass and another of flashed opal glass held before a frosted electric bulb to show the superior diffusion given by the opal glass (lower photo)



This diagram explains the simple optical principles that govern all varieties of enlargers

You will see what I mean by proper diffusion and even illumination by studying the two test photographs at the left. These were taken under identical conditions. In each, a sheet of glass 8 by 10 in. was held 6 in. in front of a 100-watt, frosted electric light bulb. The lower photograph, which shows even illumination clear to the edges, was made of a sheet of flashed opal glass. Such glass is translucent but not transparent. In other words, all light rays that reach glass of this type are completely broken up or diffused.

The other view is of a sheet of ground glass. Note the poor diffusion. There is a strong bright area opposite the bulb, and the edge areas are dimly lighted. If you were to place a negative in front of the opal glass, it would appear evenly lighted at all points. If placed against the ground glass the lighting would appear decidedly uneven.

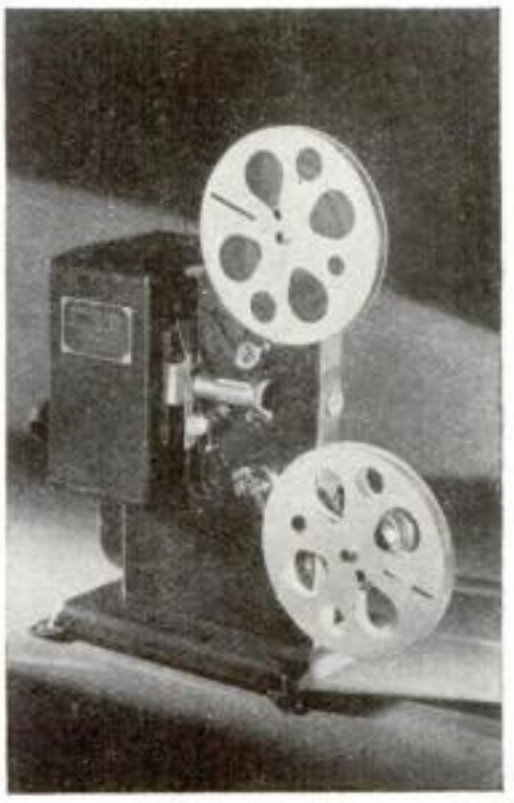
In home-built enlargers, uneven illumination is a common cause of poor results. If you make your own enlarger, be sure to use flashed opal glass to diffuse the light, and fit the electric light bulb at least 6 in. back of the glass.

Flashed opal glass can be obtained in all standard plate sizes from any large photographic supply house. It costs about 50 or 60 cents *(Continued on page 90)*

EASTMAN NEWS BULLETIN FOR THE AMATEUR PHOTOGRAPHER

MARCH, 1933, PUBLISHED BY EASTMAN KODAK COMPANY

A SEVERE MOVIE CAMERA TEST. Every Ciné-Kodak Eight must be able to photograph the radial chart shown at the left and produce a movie that shows accurate focus, steady operation, and sharp definition. A test film of each camera is kept on file at the factory. Although this new camera sells for only $29.50 it is a masterpiece of precise design, and takes fine, clear movies—20 to 30 scenes on a $2.25 film. About ten cents a shot.

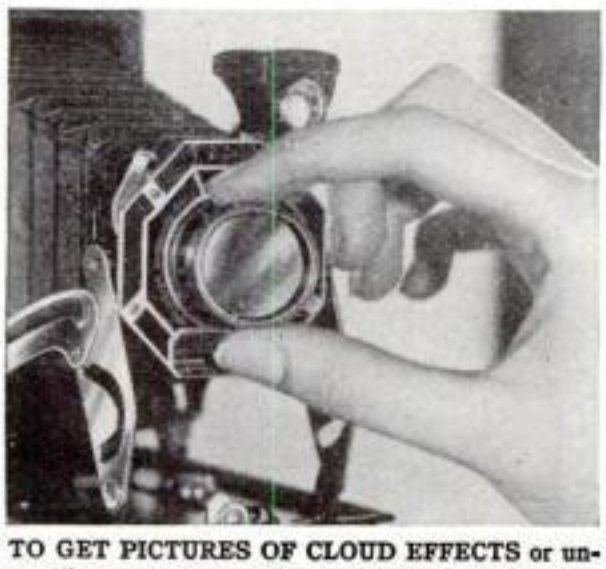


KODASCOPE EIGHT. The Kodascope Eight—beautifully made to project clear, steady home movies from the new inexpensive Ciné-Kodak Eight film, only 8 mm. (1/10 inch) wide. Model 25 shown at right, $34.50. Other Kodascope Eight Models, $22.50 and $75.

BUILT-IN EXPOSURE GUIDE simplifies the use of the fast *f*.4.5 lens shown on the Kodak Six-16 below. Indicator attached to iris diaphragm shows correct shutter speed for any stop opening and light—a great convenience. Picture size, 2½ x 4¼—price, $30. Kodak Six-20 (2¼ x 3¼) with *f*.4.5 lens—$28. At Kodak dealers'.

FOUR FOCAL LENGTHS FROM ONE REGULAR LENS. The Kodak Recomar shown above uses inexpensive supplementary lenses ($3.50 each) with its regular *f*.4.5 lens for copying, telephoto, and wide angle work, instead of special lenses costing many times as much. Pictures show enlarging effect of supplementary lens "B" compared to regular lens alone. High speed lens and shutter, double bellows extension, optional use of plates, film pack, or panchromatic cut film with ground glass focusing are other features. Two sizes, 2¼ x 3¼ at $40...3¼ x 4¼ at $48. Booklet on request.

MINIATURE PRECISION CAMERA. Hardly larger than your hand, Kodak Pupille (below) carries an *f*.2. Schneider Xenon lens five times as fast as an *f*.4.5—takes pictures in almost any light. Its critically sharp negatives, 1⅛ x 1⅝, may then be greatly enlarged. With Compur Shutter, $75. Write for booklet.



TO GET PICTURES OF CLOUD EFFECTS or unusually accurate rendering of highly colored landscapes, flowers, art objects, etc.—simply slip a color filter over the lens. It costs as little as 75c and often greatly improves picture quality.

WHAT A DIFFERENCE COLOR MAKES. With this Kodak Transparent Oil Color Outfit you can give your prints and enlargements the beauty of delicate, rich coloring. Comprehensive instruction book makes their use simple. Complete outfit, $3.75.

THE OPTIPOD. A handy pocket-size device that clamps to chairs, shelves, tables, etc., to solidly support your camera. Also fits on tripod to give you an adjustable tripod head. Permits tilting and turning camera. At your Kodak dealer's, $1.25.

INFORMATION REQUEST PS 3-33

Eastman Kodak Company, Rochester, N. Y.
Please send me literature regarding items mentioned in your March Bulletin, as checked below.

Ciné-Kodak Eight ☐ ☐ Recomar
Kodak Six-16 ☐ ☐ Pupille

Name .....

Address .....

Automatic Mail Bag Pick-Up

AND OTHER MODEL RAILWAY HINTS

ONE of the most interesting and easily made accessories for any model railroad is an automatic mail bag pick-up. On real railroads it is the practice to pick up the mail bag from small local stations without stopping the train at all. The bag is suspended from the end of a cross arm on a pole beside the track, and the mail or baggage car is fitted with a hooklike arrangement that catches the bag and carries it along with the train as it rushes by.

The illustration at the right shows the simplest model of this set-up. The miniature mail bag should be sewed up with a wire ring at the top and then kicked around on the cellar floor for a while to give it the characteristically drab appearance of a real, well-used mail sack.

Fit a wire hook at the side of the station or on a pole near it, with the long point of the hook parallel to the track and pointing in the direction the train is traveling. Next fasten a similar hook in the door of the baggage car or other convenient place. Have it point in the same direction and place it so it will pass under the hook at the station.

A still more tricky fixing is to arrange the wire on the train in a downward curve so that the mail bag will swing in the door and out of sight. This permits several mail bags to be picked up, one after the other, without stopping the train. This gives a surprisingly realistic effect, as if a mail clerk were actually inside the car to take the bags.—CARL ROHLFS.

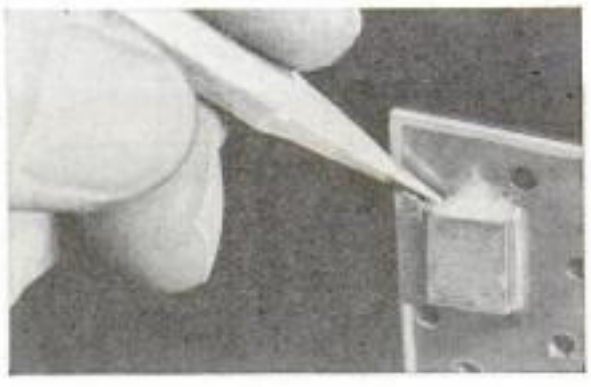
As the train passes the station, a hook projecting from the baggage car automatically picks up the sack

Imitating Grass With Sawdust

FROM any woodworking shop you can obtain for the asking all the sawdust you need to make grass and underbrush for the scenery of your model railway.

Prepare a solution of green household dye, being careful not to get it too strong. A little dye goes a long way. Pour the sawdust slowly into it as shown at the right, and after it has soaked up enough color, pour off as much of the solution as you can and spread the sawdust in a thin layer on newspapers to dry. Paint the area with a thin solution of glue and sprinkle on a layer of the dyed sawdust. For uniformity, it is best to sift the sawdust through window screening.

Bushes are imitated with bits of fuzzy rope bound with wire at one end, then frayed out, dyed, dried, dipped in glue, then in green sawdust. Add dabs of bright lacquer for flowers.—ROBERT W. HYDE.

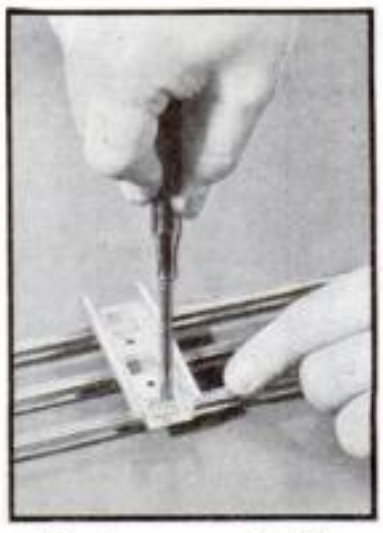


Oiling Motor Bearings

THE hardest working bearings on any model locomotive are on the armature axle shaft. The photograph above shows a special lubricator for this bearing. Solder on a small folded brass box directly over the end of the shaft. Stuff it with wool batting or, better still, with a small piece of felt cut to fit. The felt will soak up enough oil to lubricate the bearing for many hours.—WILLARD W. CHEGWIDDEN.

Longer Curves for "O" Gage Track

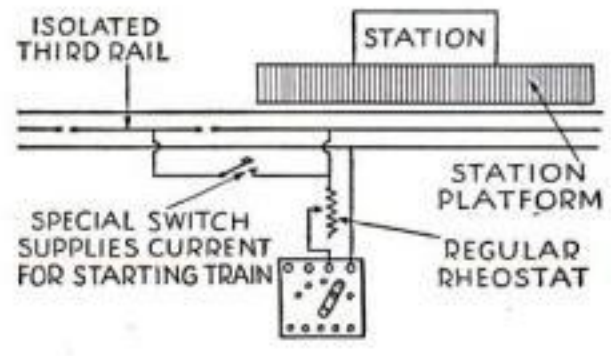
TRACK supplied for "standard" gage trains is made with much easier curves than are used for "O" gage track. Therefore, to obtain longer curves on an "O" gage railroad at some particular point, the simplest way is to buy a few pieces of "standard" gage curved track and refit the rails to your "O" gage ties. This is practical because "O" gage and "standard" gage rails are identical in cross section. To release the rails, place the track upside down and hold it firmly while you force a screw driver down past each side of each rail. The "standard" gage rails are fastened in the "O" gage ties by placing a nail set with its point at the center of the lip and giving it a light blow. Simple bending is sufficient to hold the insulated center rail.—WILLIAM ATKIN.



How to open up the lips on the underside of the ties to release the rails

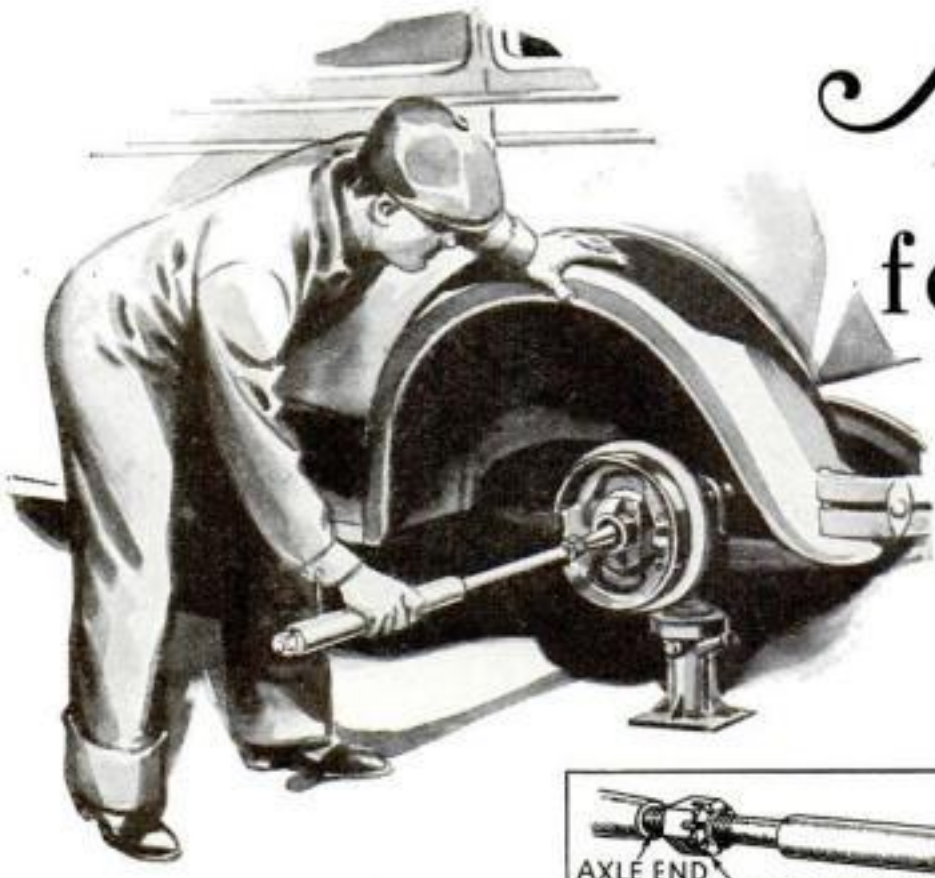
Train Stops But Lights Stay On

ORDINARILY, shutting off the current to stop the train at a station also puts out the lights in the coaches. This somewhat spoils the realism of the effect. It can be eliminated by wiring the track as shown below. Pick the section of track where the locomotive normally stops and remove the third-rail pins. Supply current to this one section of track through a separate switch. As the train approaches the station, slow it down with the control rheostat so that it will stop when it strikes the dead section.—WILLIAM BROWN.

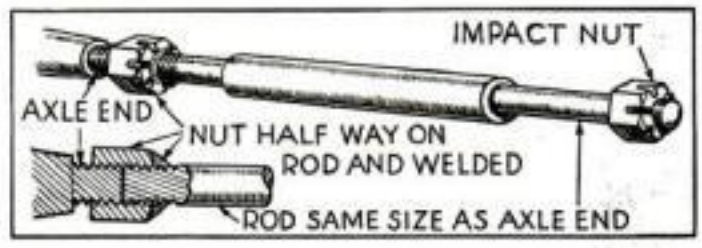


A Kit of Ideas for MOTORISTS

Useful Hints for Emergency Car Work Contributed by Our Readers



A tool that aids in the removal of a rear axle can be quickly put together with an iron rod, a section of pipe, and two regular axle nuts



Homemade Tool Aid In Removing Axle

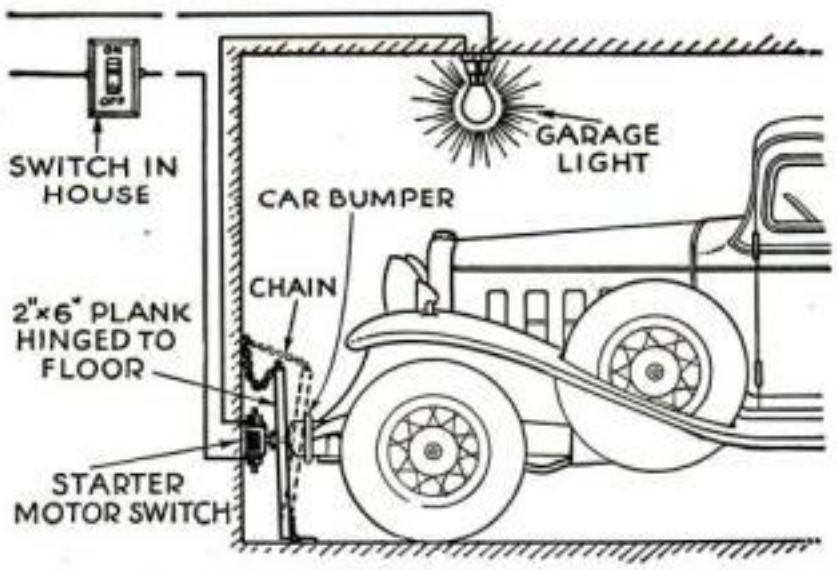
REAR axles that are to be removed can be loosened with a tool made from a twenty inch length of iron rod, a twelve-inch section of pipe large enough to fit over the rod, and two axle nuts. The rod should be the same diameter as the threaded end of the axle. One nut, which matches the axle, is screwed half-way on one end of the rod and is welded as indicated in the drawing. The pipe is then slipped on the rod and the second nut screwed in place. By means of the free threads on the welded nut, the tool is screwed on the threaded portion of the axle. Bumping the pipe against the outer nut drives the axle loose.—B. A.

An Easy Way to Make Your Own Mud Chains

EASILY adjusted mud chains can be assembled from scrap pieces of chain and double-ended snap fasteners. Each mud chain consists of a piece of chain long enough to fit snugly around the tire and the wheel rim. The loop end of the snap clamps to the link at one end of the chain. To apply the chains, the snap end of the fastener is hooked into the other end of the chain.—K. C. M.

Board in Garage Turns on Light

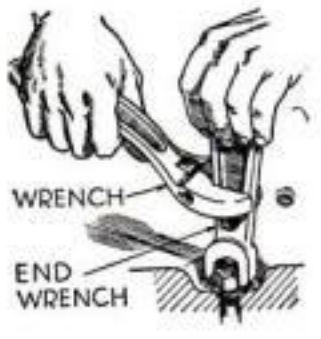
A DISCARDED automobile starter motor switch can be rigged to form an automatic control for the garage lights. As shown in the illustration, the switch is fastened to the rear wall of the garage on a level with the axles of the car. A board, two inches thick, six inches wide, and three or four feet long is hinged at its bottom in such a way that its upper end comes in contact with the switch button when it is pushed up against the wall. The upper end of the board should be supported with a short length of chain. When the car is driven into the garage, the bumper pushes against the board and operates the switch, turning on the lights. The hand brake is then set to hold the car in this position. Another switch in the house turns the lights out. With the car in place, the lights likewise can be turned on. When the car backs from the hanging board, the lights will be turned off.—W. R. W.



Drawings shows how starter motor switch, a board, and a piece of chain can be used to make an automatic garage light switch

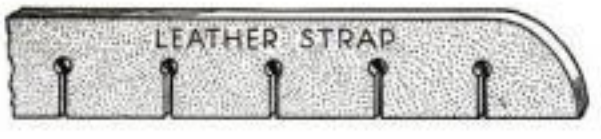
Handy Socket Wrench

YOU can tighten a bolt that requires a socket wrench by using an end wrench and an adjustable wrench. Fit an end wrench over the head of the bolt in a vertical position. The adjustable wrench is used to supply the necessary leverage as shown. It is best to place it close to the head of the end wrench to reduce the twisting movement on the handle of the end wrench.—C. R. W., Jr.



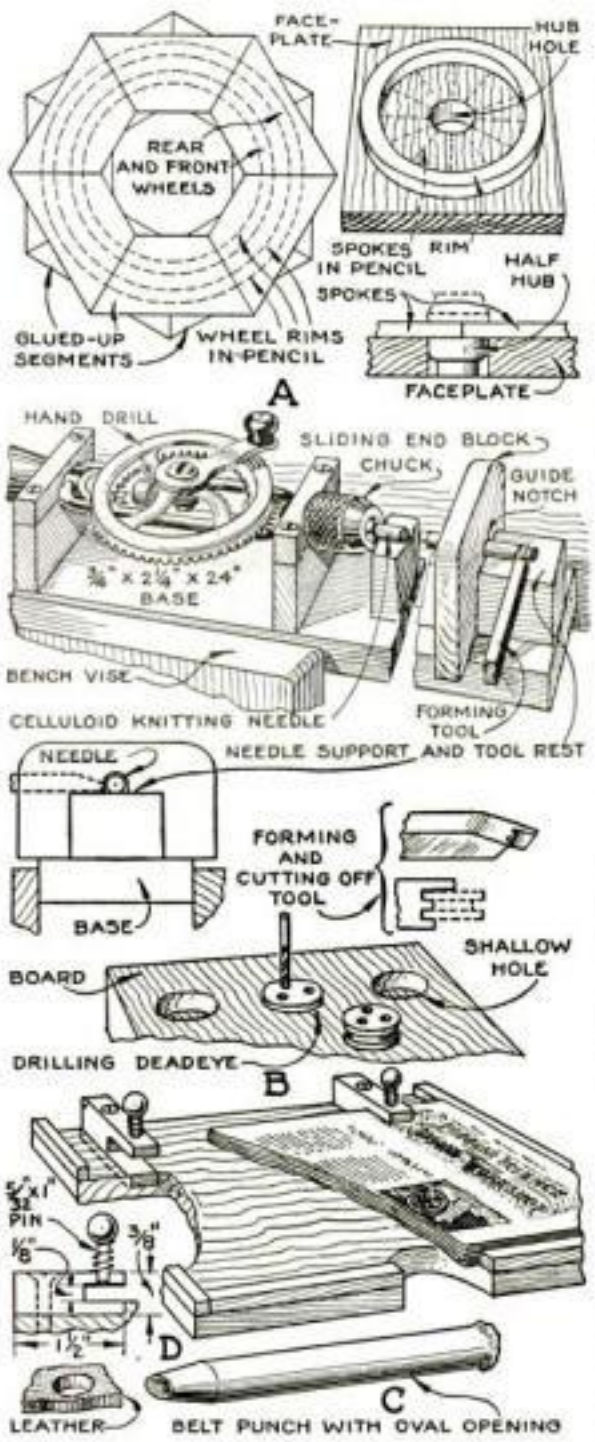
Leather Ends Radiator Rattle

RADIATOR shutters of the permanent type often become worn and noisy. To remedy this I devised the leather supporting strip shown in the illustrations. This fits over the edges of the shutter blades at the bottom of the radiator front. The strip was made from a piece of leather belting, about one and one half inch wide. First, I marked the locations of the shutter blades on the strip. Then I drilled holes at each mark and cut narrow slits to the edge. The anti-rattler slips in place as shown.—J. G. P.



HELPFUL HINTS FOR THE MODEL MAKER

IN BUILDING a copy of the POPULAR SCIENCE MONTHLY stagecoach model *Diamond Tally-Ho,* Carl W. Printz, of Massillon, Ohio, saved time by gluing up the stock in two layers as shown at *A,* the segments being wide enough to allow both a front wheel rim and a rear wheel rim to be cut out. After mounting the stock on a wooden faceplate, he marked the circles, laid out the spokes, turned a hole in the faceplate to receive half of a hub, and turned both rings. Then he

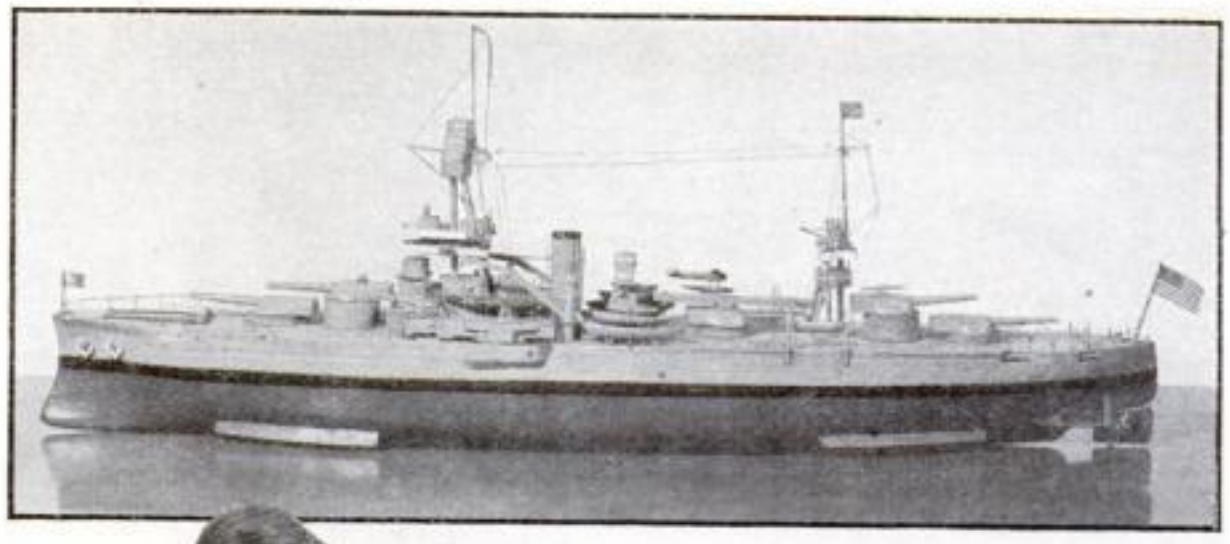


Simple ways to make wheels, deadeyes, and blocks for models; and a special paper punch

placed a half hub in the hole, glued the spokes for the front wheel in place against the rim and on the hub, and nailed on the other half of the hub. Removing this wheel, he made the rear wheel similarly.

To make deadeyes for a model of *Old Ironsides,* he used a hand drill in a fixture constructed as shown at *B.* Next, he drilled a number of shallow holes in a board, dropped deadeyes into them, and drilled three holes in each deadeye with a No. 60 drill. The pulley block blanks were cut from leather by using a belt punch with an oval opening as shown at *C.*

Another homemade tool he devised is the punch shown at *D* for perforating magazine pages for a loose leaf binder.



Completed model of the *Texas* and how she looks in the water

We Launch Our Battleship Model

By Capt. E. Armitage McCann

LITTLE work now remains to complete the model of the battleship *Texas*, if you have kept up with the instructions published in the preceding four articles in this series. The identifying numbers mentioned in the following description of the few parts still to be made refer to corresponding numbers on the assembly and detail drawings that appeared in the second article (P.S.M., Dec. '32, pp. 72 and 73).

Six large searchlights are placed on the model, but I omitted the four or more small ones which go on deck *20*. Detail *60* shows how to make a searchlight. A piece of dowel is cut as indicated, and a strip of brass bent to shape and fastened with a clinched pin swivel. I fastened four of the searchlights to the wings of platform *47* by drilling a hole through it, and through this I flowed a spot of solder. The two which are placed on the wings of deck *20* have a small round base and are fastened with a pin.

To the weather screens of deck *26* should be fastened the side lights, green to starboard and red to port. They should be double as shown in detail *28*. Metal or wood screens with bead lamps may be used to give a good representation of them.

At the stem stands the jack staff *(1)* to carry the union jack. It can be of wood, but is better if made of brass rod, because it is so slender and so likely to be knocked. It is set in a hole in the deck or in a little socket. About ⅜ in. up, to steady it, there should be a brass band to which is soldered a forked wire, the ends of which are set in the deck. The staff should stand upright. The ensign staff *(63)* is similar but longer; its band and support are about ¾ in. high, the legs sloping slightly aft. Both should have trucks and be painted gray.

At the foremast head there can be a commission pennant—a swallowtail, which I have exaggerated somewhat in length. At the main there might be the admiral's flag of four stars on a blue ground. Just by way of decoration I hoisted a flag at each yardarm —the cornet to starboard because that is the crew recall and our ship seems to lack only a crew, the admiral being, let us suppose, in his cabin; and, to port, the battle efficiency flag. Of course, when she is under way, the jack should come down and the ensign go to the gaff.

At the positions shown there should be bitts or bollards *(5)*. These are best cast from metal with holes for nailing down, but can be cut from wood or indicated with a ½ in. long plate and two escutcheon pins. On each side of the bitts are chocks or leads *(6)* made from a piece of metal bent to shape and filed up. Right aft there is a pair of bitts cut in half and nailed on each side, in line with the hull; this forms a towing lead.

The radio antennas require careful work. Have a double wire on each side from yardarm to yardarm. Solder a fork of the thinnest wire to the ends of a ½-in. length of stiff wire. Make two of these and pin them on a board not quite as far apart as the distance between the yards. Start a thin wire at the after stretcher, go around the forward one, and leave enough to stretch down to the radio room *(25)*. Solder the wire in position. Repeat for the other side. Lash the forward fork to the extreme yardarm and make a little hook at the other end to hook onto the after yardarm, so that it can be undone when you want to remove the center portion to adjust the machinery, if there is any. Bore holes in the sides of the radio room and peg the wires in position.

The emergency antenna running to the top of the after tripod is omitted, as is the wire from the fore crow's nest to the jack staff and the wire from the searchlight platform to the ensign staff.

I also omitted a number of mushroom and other ventilators, ammunition hoists and small hatches, and a varied collection of small rung ladders and tubes running here

and there, but all the prominent features are embodied—everything that is essential.

The edge of the shell plating rises about 9 in. above the deck level, and inside that there is a 12-in. waterway. To represent this I ran the side painting 1/16 in. onto the deck.

I had first thought of leaving off all the deck stanchions because they are made to lie down when the ship is in action, but she looked bare without them so I set in standard three-ball 5/16-in. stanchions (⅜-in., however, will do). These are set 3/32 in. in from the edge. I spaced them somewhat widely apart, averaging ¾ in. Eighty are required. It is customary for ship model makers to buy their stanchions from dealers in ship model supplies. Stanchions can be made, however, by drilling brass rod at the correct intervals and turning down between the holes in a lathe. This is a tedious job, and various substitute methods are possible, such as using thin twisted wire or very thin split cotter pins. It is all a matter of personal preference and ingenuity. A sketch was given in the December issue of the regulation battleship stanchions, but they are much harder to make.

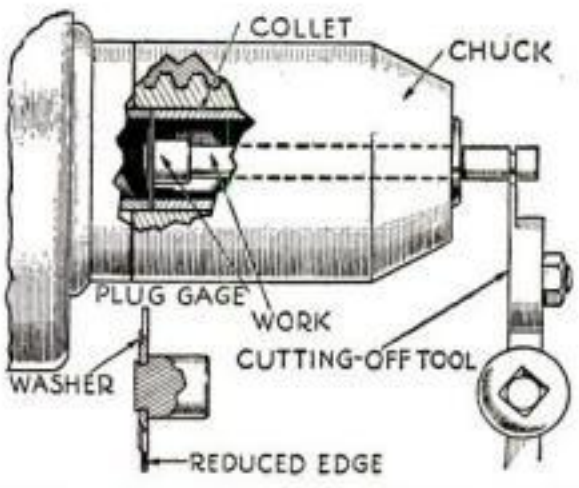
On the stern at the position indicated, the name of the ship TEXAS should be painted in ⅛ in. high block letters. This lettering is black. Then your model will be complete.

She has been quite a bit of work to make, but worth it. When she is ready to launch, whether figuratively on the mantelshelf or actually in the water, you will have the satisfaction of knowing that you have constructed an accurate, good-looking scale model of one of the finest and most powerful American battleships.

UTILIZING SHORT STOCK IN A SCREW MACHINE

A HAND screw-machine job that called for a large quantity of steel rods, uniform in length, was turned out in an economical way by using a lot of waste pieces that were available instead of cutting them from long stock. Because these pieces were short, it was found necessary to chuck them by the "work" ends and insert them from the tool side of the chuck. To facilitate this, a simple gage or plug was made as shown.

A short piece of stock was turned down to fit the hole in a large washer, a shoulder



Screw-machine chuck broken away to show how a gaging plug was inserted behind the collet

being left to keep it from slipping through the hole. The turned down end was then riveted over to hold the washer in place. Once more the plug was chucked and the washer turned down to the inside diameter of the spindle in the screw machine. The thickness of the washer also was reduced around the edge.

The plug was placed in the spindle, followed by the collet in the usual manner, and it then served as a dependable gage for length.—JOHN E. SERAFIN.

HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

Flying Airplane Models

Bremen (Junkers, 3-ft. Flying), *89-90*	$ .50
Lindbergh's Monoplane (3-ft. Flying), *69*	.25
Nieuport XVII (29-in. flying), *180-181*	.50
Rise-off-Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (Record 12½ min.), *102*	.25
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CHEMICALS FORM QUEER UNDERWATER GARDEN

AMONG the many attractive things that can be made by the amateur chemist, the chemical garden is one of the most unusual. It can be "grown" in a bottle, vial, glass vase, fish bowl, or other transparent receptacle. When the proper chemical is introduced into the liquid, a small treelet will shoot up.

Fill the glass receptacle about three fourths full of a mixture of one part of water glass (silicate of soda solution) to three parts of water, thus making a twenty-five percent solution. Now drop a small crystal of one of the following salts in the liquid: blue vitriol (copper sulphate) for blue trees; potassium dichromate or, as

Strange treelike forms are "grown" by dropping certain salts into a thin solution of sodium silicate

an alternative, chloride of iron, for orange trees; potassium permanganate for purple; nickel sulphate for green; and lead acetate or silver nitrate for white. These salts are usually found in the amateur's outfit, and they are easily obtained at a druggist's.

Watch the crystal for a moment; if it starts to grow, all right. If it doesn't, add a very small amount of pure water glass to make the solution stronger. When the first crystal has grown to a fair size (from ½ to ¾ in.), drop crystals of different colors over the bottom of the receptacle.

After the trees have stopped growing, carefully siphon off the remaining liquid. The glass may then be filled with water, which reveals the colors of the trees clearly. However, if the garden is to be set in a place where it may receive a good deal of jostling, it is best to prepare, by cooking, a heavy gelatin pudding. Take care to keep it clear and transparent. Pour this in around the formations instead of the water and allow it to set until the gelatin is firm.

Several photographs of the author's chemical garden have been taken, but while they show the general shape and size of the trees, they convey no idea of the colorful effect—green and greenish-blue trees grown around a group of shells that are red and orange in color.

The chemist may vary the design by placing a small model of a galleon or pirate ship or a tiny treasure chest on the bottom of the bowl, for the garden resembles sea plants.—L. L. HYLER.

Our CONSTRUCTION KITS

Will Save Your Time

KIT NO. 3

KIT D

KIT NO. 4

BY SENDING $1 to the Popular Science Homecraft Guild, you can obtain a construction kit of raw materials for making a highly simplified 12 in. long model of the new American built liner *Manhattan*. The kit contains a piece of white pine for the hull, sawed to the approximate shape but otherwise unfinished; wood of the correct thicknesses for making the various deck units, bridge, funnels, lifeboats, and similar parts; sheet metal for the rudder, anchors, propellers; soft wire for the masts, ventilators, and davits—in fact, everything but the paint. A blueprint showing all parts full size is included.

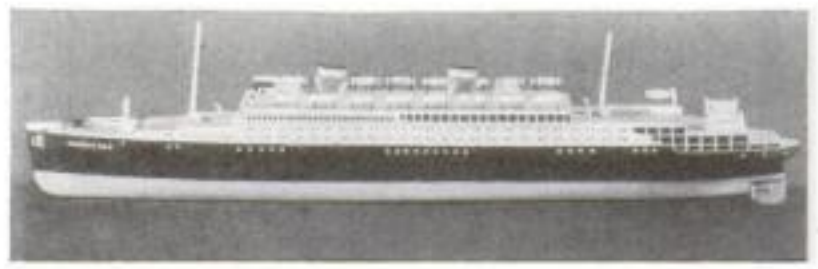
Because of the small size and unusual simplicity of this miniature model, it is an excellent one for beginners and will serve as a pleasant introduction to the fascinating hobby of ship model making.

This new kit is marked *F* in the list below. It will be mailed postpaid to any reader in the United States for $1, but cannot be sent C.O.D. The other kits available are also listed. Each is accompanied by instructions or blueprints.

NO. 2

KITS B AND C

KIT A



KIT F—Materials for 12-in. model of *Manhattan*

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154. The hull is 20½ in. long.....$6.90

AA. Same with hull lifts sawed.... 7.40

B. Folding muffin stand in selected sugar pine, 11 in. wide, 19 in. long and 33 in. high when open. All the necessary wood cut to approximate sizes but not machined.. 2.90

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D. Spanish Galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.... 6.45

E. Battleship model, U. S. S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

EE. Same with hull lifts sawed.... 7.45

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No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.90

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Note: Prices of all kits except F are 50 cents higher west of the Mississippi River because of heavy shipping charges. Kit F is not sent C.O.D. This offer is made only to readers in the United States.

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HOLDING FINE DRILLS IN A LARGE CHUCK

THE AMATEUR mechanic often finds it necessary to use fine wood and metal drills in chucks too large to grip them firmly. His first thought is to wrap the drill with tape, and he soons finds this to work only indifferently. If a drill chuck such as is used on small lathes is available, he can slip a rod of metal or hardwood into the spindle hole at the rear end of the chuck; then tighten the set screw

How the length of metal rod is cut in making the improvised chuck for small drills

and grip the rod securely in a larger drill chuck.

When no small chuck of any kind is available, slot a 2-in. piece of ¼-in. hardwood dowel for a distance of 1¼ in., slip the drill into the slot (being careful to center it), and grip the dowel very tightly in the chuck. The wood will be somewhat crushed by the jaws of the chuck, but it will hold the drill firmly for a considerable time.

Where a good deal of drilling is to be done, it is better to use a metal rod. Brass rod 5/16-in. in diameter serves very well. Drill a 1/16-in. hole through the rod ½ in. from the end and hack-saw it carefully from end to end. With a triangular file work out a groove 1/64 in. in depth down the center of the sawn faces to hold the drill. Now file away a little of each face from the rivet hole to the nearer end, as shown in the drawing. Insert a loose fitting copper wire rivet in the hole. This improvised chuck will open under slight pressure and grip fine drills like a bulldog. The metal rod will last indefinitely.—JACK HAZZARD.

MAKING ROUND HOLES IN CORK STOPPERS

WHILE a cork borer is not ordinarily a part of the tool equipment in the average home chemistry laboratory or workshop, the amateur can easily make holes in cork stoppers and the like by the following method: Heat the tang of a small rat-tail file and burn the hole through the cork to approximately the right diameter; then carefully round it off with the rat-tail file.—GEORGE A. SMITH.

"Our Readers Say" is getting to be one of the most diverting and interesting features in the magazine. If you have not written in to the Editor of *"Our Readers Say"* why not break into print with some idea that you are interested in. Your letter will be welcome.

TRAILING CRYSTALS WITH A MICROSCOPE

(Continued from page 47)

transmits light. No other crystal family, however, supplies such a limitless profusion of forms, there being, apparently, no end to their delicate, lacy patterns. Every snowflake is a distinct creation in a frozen world that contains countless trillions of other forms. Here geometry is wedded to sheer beauty. In looking at our flakes, we must not make the mistake of using a high powered objective. Anything from twenty-five to fifty diameters will be plenty.

STUDENTS of ice crystals have found two main classifications—the tubular and the columnar. Often the two forms are combined with the result that a column or rod of hexagonal section will have at one or both ends a hexagonal plate. Star-shaped crystals are most abundant when the temperature is just a bit below freezing. The hexagonal plates make their appearance in great profusion at lower temperatures.

Examination of the frost crystal that forms on windows reveals extremely interesting sights. A cold piece of glass moistened by blowing the breath against it, is placed in the garage where the moisture will freeze. Studying this specimen, we find the tiny little bricks of water have grown together, each, it would seem, clinging to the other for companionship in this barren and frozen world.

Aside from the crystals already mentioned, there are many others in the family medicine chest and the kitchen. Then at the drug store we may purchase copper sulphate, and the salts of the alkaline metals.

If we can obtain some crystals of galena or garnet, we can make some interesting observations. Galena, sulphide of lead, is the chief ore of lead.

We cannot examine this or any other opaque crystal as we did the transparent crystals. Galena is a dull gray and will not pass light. Hence the little mirror underneath the stage of our instrument will be useless and we must manage to throw the light down upon the surface of the crystal. This is best done with a reading glass with a universal joint, set on a stand so that it may be focused at any point.

HAVING arranged the light source, we proceed with the examination. Here two hundred diameters or more, depending upon the skill of the operator, may be used. First, we must polish the surface of a tiny piece of galena. To do this, it is held against the side of a fine emery wheel and, when ground flat, is polished with rottenstone and water.

This done, the piece of galena, resting on a slide, is placed upon the stage of the microscope. Now the light is focused on the surface of the galena through the medium of the little reading glass and its universal joint.

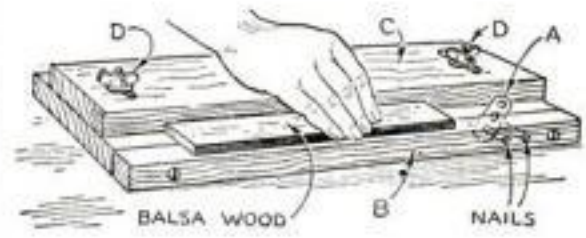
Working at night with a microscope, we find that ordinary electric light is tiring to the eyes. To overcome this, we build a special light filter that is a real joy to use, and is easy and inexpensive to make. The inside of a coffee can is painted black after small holes for ventilation have been punched near the top and a large hole made for the escape of light. The beam of light from the can is passed through a solution of copper sulphate (or blue stone) arranged in a little container made of two small pieces of window glass. The wooden sides and bottom of this cell are made waterproof with tar or pitch.

Just enough of the copper sulphate is dissolved in water to impart a good blue color. This cell is then placed between the light from the can and the mirror on the microscope. In this position, it filters the heat out of the light and provides an illumination that does not cause eyestrain.

SPLITTING BALSA WOOD INTO THIN STRIPS

BALSA wood strips for building model airplanes can be cut rapidly and accurately by using the adjustable cutting block illustrated. A razor blade *A*, preferably of the double-edged type, is clamped securely between the wide and narrow parts of the baseboard *B*. It is advisable to drive a nail or a long, thin screw through the lower hole of the blade and another just behind it to prevent the blade from turning down into the crack.

The fence or guide *C* is fastened by means of two bolts and wing nuts *D* at a distance from the blade equal to the width or thickness of the strips to be cut. The balsa stock is then pushed along the base block against that edge of the blade which forms an obtuse angle with the board—the forward edge.—BARRY TELFAIR.



The cutter is a razor blade of the double-edged type fastened in place at an angle

EMERGENCY REPAIR FOR SPLIT SAW HANDLE

WHEN a saw handle splits, the usual procedure is to buy a new one, provided there is no rush to use the saw. In an emergency, however, a broken handle often can be repaired by the method illustrated. In fact, this particular repair proved so satisfactory that a new handle has thus far proved unnecessary.

A ½-in. hole is bored through the grip about 1½ in. below the break, and a ¼-in. hole is bored down from the top of the handle to meet the first hole. This small hole is counterbored with a ½-in. bit to a depth of ¼ in. Then a ¼-in. machine bolt is inserted, its length being such that the end extends for a few threads into the ½-in. hole. The side of this hole toward the break should be rasped flat to afford a surface for a nut. After the nut is tightened, the holes are filled with a commercial wood composition putty and afterwards sanded smooth and revarnished.—W. C. WILHITE.

WHEN it is desired to mend a valuable piece of china and time is not an important factor, a thick white lead paste will prove to be an excellent cement for the purpose. Smear a small quantity of the white lead on the surfaces to be joined and then press the parts together firmly. The piece should not be used for at least three or four months.—H. B.

Harness Repairing for Farmers

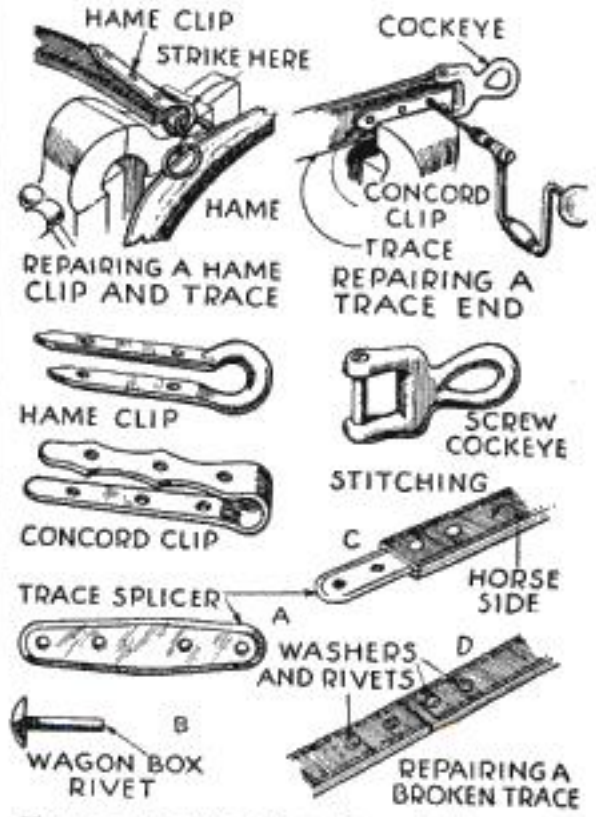
By L. M. ROEHL

New York State College of Agriculture

MORE strain is placed on the traces or tugs of a harness than any other part, consequently these most often break. There are three points at which repair work usually is required: The hame clip becomes worn out; the cockeye is worn through or tears out at the end of the trace; the trace wears thin and breaks where it chafes against the leg of the horse.

To replace a hame clip on a tug:

1. Remove the old rivets. This may be done by clamping the tug securely in a machinist's or blacksmith's vise and cutting off the heads of the rivets with a cold chisel and a hammer, or the heads may be center punched and drilled off, and then the rivets punched out. If a two-hole clip has been



How a hame clip and a Concord clip are put on a trace, and how a broken tug is spliced

used, it may be desirable to replace it with a three-hole clip, as it is longer and will give added strength.

2. Hook the hame clip into the hame staple and drive it in place on the tug with a hammer. The clip can be forced down tight on the tug by resting one side of the ring of the clip on the vise or other solid metal surface and firmly striking the other side with a hammer.

3. Draw the holes in the clip in line with those in the tug with a pointed tool such as a scratch awl.

4. Use hame rivets or other soft iron rivets, driving them in from the horse side of the tug. File or grind a chamfer on the points of the rivets and they will drive into the holes freely.

5. With hack saw or cold chisel, cut the ends of the rivets so as to leave projecting ends of not over ⅛ in., and with the ball end of a ball peen hammer rivet the clip down tight, neatly rounding the ends of the rivets.

If a cast cockeye has been used and is worn out, remove it with a hammer and cold chisel and replace it with a screw cockeye. If the cockeye has worn through the leather at the end of the trace where it is

folded around the bolt of the cockeye, it is repaired with a Concord clip. Proceed as follows:

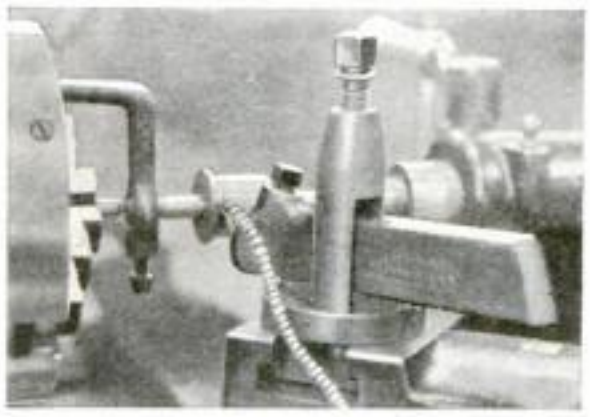
1. Cut the torn end of the trace off square.
2. Place the cockeye in the clip and the clip on the trace. Then clamp it in a metal vise in its final position on the trace.
3. With a carpenter's brace and a metal drill of the same size as the holes in the clip, drill holes through the trace for the rivets.
4. Use soft iron rivets; drive them in and cut them off so as to leave projecting ends of not over ⅛ in., and rivet them down tight. If there is a tendency for the clip to spread away from the leather, the riveting may be done while it is clamped in the vise, using a sledge or other heavy metal tool to hold the rivet in place while hammering.

IF A TRACE is broken it may be repaired with a trace splicer, which is a piece of metal as shown at *A*. If a splicer is not at hand, a metal plate may be cut 4 by 1 by ⅛ in. and drilled with four ¼-in. holes 1 in. apart. The ends are rounded and the edges filed or ground off for easy insertion between the layers of leather.

Having a splicer, the repair is made as follows:

1. The broken ends of the trace are cut square to the edge.
2. Place the squared ends together and the splicer on the leather with an equal part on each end of the trace, and mark the places for the rivets.
3. Holding the trace in the vise, drill holes for the rivets the same sizes as the holes in the splicer. Wagon box rivets *B* are desirable because their large thin heads make a smooth surface for the horse side of the trace and will not chafe the horse.
4. Drive one end of the splicer between layers of leather as shown at *C* and line up the holes by the use of a scratch awl or other pointed tool.
5. File or grind the ends of the rivets somewhat pointed and drive them through the trace from the horse side.
6. With hack saw or cold chisel cut off the ends so as to leave not over ⅛ in. for riveting.
7. Place washers on the rivets and rivet the ends down tight.
8. Drive the other end of the splicer in place and rivet in a similar manner as at *D*.

SPECIAL LATHE CENTER FOR USE WITH CHUCK



A SOFT center like that shown in the sketch below will make it unnecessary to remove the universal chuck from a lathe when some small job comes up that must be machined between centers. The frequent removal of a large chuck is often inconvenient. In use, the center is held in the universal chuck with the index mark under the No. 1 jaw. The work is driven by a dog with its tail pressing against a chuck jaw.—J.H.D.

INDEX MARK FOR
No 1. CHUCK JAW

Auxiliary center for holding in a chuck

METAL SPINNING

(Continued from page 65)

against which the revolving tailstock center presses. Thus the form, blank, and button rotate as one piece. Pressure of the tool against the disk causes the metal to flow around the form, conforming perfectly to its outline. The metal is stretched, compressed, and bent in the process; and the secret of good spinning is to effect these changes without creating grooves, cracks, or other imperfections.

You can make wood forms directly on the spinning lathe, but metal ones require a metal working lathe or an auxiliary carriage for the spinning machine. First, equip your spinning lathe spindle with an intermediate chuck, unless you can screw the form directly on the spindle.

The intermediate chuck is a collar that is screwed or otherwise fastened on the end of the spindle and has projecting from it a threaded stud from ¾ to 1 in. long. Some metal spinning lathes are equipped with a threaded taper screw on the intermediate chuck. However, Stolitzka has found that such taper threads are not as safe and have many disadvantages when compared with the ordinary straight type. The straight thread is easy to cut, and corresponding taps can be obtained for threading the wood or metal chucks.

ON THE spinning lathe illustrated, the intermediate chucks have ¾-in. studs with 10 threads per inch for light and medium work, and 1-in. or larger studs with U. S. Standard threads for heavier spinning.

After the chuck blank is drilled and threaded to fit the intermediate chuck, turn it to conform to the inside or outside of the desired spinning. Before doing this, draw a full sized section of the article you want to make, and prepare a sheet metal template for use in checking the form.

Wood chucks can be used where one or two articles are to be spun, but metal ones are preferable for larger quantities. In addition, they give more accurate results. Many types of spinning require sectional or knock-down chucks. These will be discussed in a later article.

You can do much spinning with a single tool that consists of a ¾- or 1-in. rod of tool steel with an 18-in. handle at one end and with the other end shaped somewhat like a snake's head. The business end must be hardened and polished. This description probably gives the impression that such a tool is massive. It must be, for it receives rough usage. Many of Stolitzka's tools have handles made from baseball bats.

IN ADDITION to this common spinning tool, there are others with round noses, pointed noses, fishtail noses, curved ends, and with wheels of various forms. Wheels are for specialized work mostly, so that the beginner need not worry about them. However, a tool equipped with a small pulley wheel set in a slot is employed for spinning rolled edges.

You ought also to have a tool designed to cut metal, for trimming edges. This can be made by setting a high-speed lathe tool bit in the end of a steel rod or tube and grinding the bit so that it will shave down the metal when applied to the edges. Finally, include in your tool list a piece of broom handle with one end shaped like a blunt cold chisel. This is the "back stick" so indispensable to the spinner. It is held against the metal opposite the spinning tool during the early stages of spinning, to prevent chattering and buckling. Various spinning tools can be purchased from manufacturers.

As for metals, you can employ almost anything from soft (Continued on page 89)

METAL SPINNING

(Continued from page 88)

aluminum to stainless steel. Probably the easiest metals for the beginner to tackle are copper and aluminum. Brass and zinc also are not difficult to work. Always start with a disk, the radius of which is determined by measuring around the form from the center of the free end to the edge.

When copper and some of the other metals are subjected to bending and stretching, they become hardened and stiff, and must be annealed before the work can be finished. Perhaps several annealings will be necessary if the metal is to be deeply drawn.

Anneal copper by heating it over a gas flame or with a blowtorch until it becomes soft, then cool it in air or water. Brass is softened in the same manner; but before heating, it must be hammered in order to "loosen up" the metal and prevent cracking during heating. Either rest the work against wood and pound it with a metal hammer, or use a wood mallet and a metal rest such as a tinsmith's stake. Do not make dents or otherwise change the shape.

ALUMINUM usually does not require annealing, except for deep drawing; then it must be treated in a furnace. Steel has to be annealed at a high temperature in a furnace. Zinc is softened in the same manner as copper.

After your equipment is in order and your form or chuck made, proceed as follows:

Place the metal blank (disk) against the chuck, and against the opposite side hold the wood or metal button, which is nothing but a round piece of maple, aluminum, or steel with one side flat or curved to fit the work and the other containing a shallow hole to receive the tailstock center. Run the center against the button with considerable pressure. Lubricate the blank with lard or cup grease so that the tool will not encounter excessive resistance.

Start the lathe and hold the tool as near the center of the disk as possible, drawing it towards the edges while exerting pressure. Hold the handle of the tool under your arm. You may have to use the back stick to prevent buckling. The metal will change its shape with startling ease and rapidity if you have done everything properly. When the blank has been spun to conform with the chuck, trim the edges and remove for subsequent finishing.

Just a word about the design of forms: Remember that the pressure of the chuck against the blank is all that causes the latter to revolve. Therefore, you cannot start with a chuck that has only a point touching the disk at the center. Design the chuck either with a flat center large enough to grip the blank, or else use more than one chuck, the first of which is designed so that the work can be started.

The wisdom of this will be seen in the next article, in which the making of a non-tipping ash tray will be described.

THIN, TOUGH PAPER FOR MODEL MAKERS' USE

A THIN and exceedingly tough "parchment" tissue that is well suited for covering the wings of model airplanes, making sails for miniature ship models, and similar purposes can be prepared easily at home. A good grade of tissue paper is cut into sheets, and each sheet is immersed for ten seconds in a solution of four parts of water to which has been added one part of sulphuric acid. During the dipping process the paper is held at two corners by wooden spring clothespins. The sheets should be thoroughly washed in running water before being set aside to dry.—K.M.

MAKING ENLARGEMENTS

(Continued from page 72)

for a 5 by 7 in. piece. The opal glass should be at least one size larger than the film you wish to enlarge. If it is not, the edges of the film will not be properly lighted.

The light reaching the lens from the negative is projected onto the sensitive bromide paper in the form of an inverted image, just as in an ordinary camera.

The mechanical construction of a photographic enlarger should be such that the film, the flange of the lens, and the bromide paper are held parallel to each other. If they are not, it will be impossible to focus all parts of the picture area at the same setting.

THE film negative and the bromide paper also should be held flat. In factory built enlargers, this is accomplished by squeezing the negative between two pieces of clear glass, and the bromide paper is either held by the edges against a flat surface or placed under a piece of glass.

The simplest type of enlarger is a light-tight, boxlike structure containing an electric light bulb and a diffusing glass at one end, the negative carrier near the diffusing glass, and a holder for the bromide paper at the other end. The lens is fixed at the proper point between. Fixed focus enlargers of this kind are sold at around $12. They do good work and are quite satisfactory if you are willing to limit yourself to one size of enlargement.

It is, however, far more desirable to have an enlarger capable of adjustment for picture size and picture composition. It so often happens that you want to enlarge only a portion of the original negative.

An enlarger meeting these requirements is the popular vertical type, one of which is shown at the top of page 72. Various makes and models sell at from $30 to $75 or more. The light-tight housing of the vertical enlarger can be moved up or down on its support to change the size of the picture. In some models focusing is automatic, the lens being moved by mechanism operated by the motion of the main housing.

Another illustration on page 72 shows a different way to make enlargements. Instead of buying a complete outfit, you remove the ground glass back of your regular camera and clamp it over the front opening in a special attachment that contains the light, the diffusing glass, and a negative holder. The attachment can be used with any plate or film pack camera having a removable or hinged back, or with roll film cameras if the back construction makes clamping possible.

OF COURSE, you have to build your own bromide paper holder. A bread board fitted with feet to hold it on edge does nicely. The bromide paper can be held on the easel thus formed by thumb tacks or more elaborate clamping arrangements.

There are many other forms of enlarging apparatus available. These differ widely in size of film handled, quality of equipment, and degree of enlargement possible. All, however, operate on the same optical principle.

Here is the way to avoid the common beginner's troubles:

First, make sure that the negative is evenly illuminated. You can check it by looking at the source of light with your eye in the lens position. Try it both with and without a negative in front of the diffusing glass.

Second, be sure to use the correct grade of bromide paper. If your negatives are somewhat gray, buy contrast bromide.

Third, set up the enlarging outfit in a dark room that is really dark. See that your dark-room light is fitted with orange-colored screens of a type *(Continued on page 91)*

MAKING ENLARGEMENTS

(Continued from page 90)

listed as safe for use with bromide paper. The latter is many times faster than velox and similar developing papers. Avoid placing the enlarger close to a white wall.

Fourth, take extreme care in focusing. Always use a magnifying glass to help you get the image sharply defined. Use the lens wide open on portraits, if you wish, but stop it down for any picture where you want extreme detail clear to the edges.

Fifth, always develop bromide paper for the full time recommended by the manufacturers of the paper. If you use one of the standard, bromide-paper strength, metol-hydroquinone developer formulas, this time will be from 1½ to 2½ minutes. Overexposure, and an attempt to save the print by underdevelopment, is a mistake every beginner makes.

Sixth, keep your enlarging apparatus, especially the negative and bromide paper holders, scrupulously clean and free from dust. It is a good plan to have a camel's hair brush on hand and dust off both sides of the negative and both sides of each glass every time you change negatives.

Prizes for Best Indoor Photographs

IN THE first of our $100 photo contests, which was for the best indoor pictures taken during the months of October and November, 1932 (see P.S.M., Nov. 32, p. 82), the following awards have been made:

FIRST PRIZE, $50
Augusta Strumpen, Philadelphia

SECOND PRIZE, $25
Avery Wood, Wadsworth, Ohio

THIRD PRIZE, $10
J. F. Kreps, De Forest, Wis.

FOURTH PRIZE, $5
Marion Haller, Middlebury, Vt.

FIFTH PRIZE, $5
Ruth E. Boyd, Ashton, Lee Co., Ill.

SIXTH PRIZE, $5
W. L. Prout, Rensselaerville, N. Y.

HONORABLE MENTION—*R. E. Butler, Durham, N. C.; George Carlson, Chicago, Ill.; R. Desme, Brooklyn, N. Y.; Joseph R. DiPalma, Jackson Heights, N. Y.; H. E. Esselstyn, Detroit, Mich.; M. Friedman, New York City; Fred Haitz, Jr., Sioux City, Iowa; Norman R. Hoyt, Taneycomo, Mo.; Homer Hulsey, Salem, Ore.; Aaron A. D. Jensen, Los Angeles, Calif.; Elsie M. Keyser, San Francisco, Calif.; V. A. Meder, Jackson, Mich.; H. L. Moffett, Monson, Mass.; Abraham Molind, Philadelphia, Pa.; J. R. Morton, Washington, D. C.; Elsie I. Palmer, Edgewood, R. I.; H. E. Rutland, Presque Isle, Maine; Arthur W. Sacherer, Ojai, Calif.; J. M. Stofan, Garfield, N. J.; M. L. Thiebaux, Jersey City, N. J.; Edward K. Whitcomb, Lancaster, N. H.*

The winners of the December Photo Contest will be announced next month.

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☐ Structural Engineer	☐ Marine Engineer
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HE MADE A CAREER OUT OF A HOBBY

THE first problem Herbert C. McKay faced upon his discharge from the Army at the close of the World War was the question of making a living. And the problem was a mighty serious one, for McKay returned to civilian clothes, handicapped by a physical condition that made it necessary for him to live in a mild climate.

He settled in a small town in central Florida, where living conditions were ideal for him. But the only vocation for which he was trained, that of bacteriology, was a blank as far as that town was concerned. Forced to do something, Herbert McKay determined to make photography, his favorite hobby, help him earn a living. Devoting himself to this hobby with intensive thoroughness and with an eye to the practical side of it, he soon started to earn small sums of money on odd commercial photography jobs.

It occurred to him that his knowledge of microscopy could be applied to photography in a way that would attract popular appeal. His first micro-photographs of insect and other natural life were bought by several magazines that recognized their unusual possibilities. This small success turned McKay into the field of general magazine work. In a little more than a year after his start, he was selling unusual photographs of all types and subjects to many magazines in this country and abroad.

IN 1922 McKay took a job as cameraman in one of the Hollywood production companies, but after one season returned to Florida, where he began work on a book which was to be the first one ever published on the subject of amateur motion picture photography. This book was followed by others, and in recognition of his services to photography McKay was awarded with an Associateship in the Royal Photographic Society of Great Britain. Two years later the same society awarded him with a Fellowship, the highest photographic honor available.

In 1926 McKay joined the staff of the New York Institute of Photography, and two years afterward took over the direction of the educational activities of the Institute. In the space of eight years he had become one of the most widely known authorities in the photographic profession. Beside Dr. Mees of Eastman Kodak, he was the only man in the country whose photographic work had earned him a *(Continued on page 93)*

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Secrets of Success

HE MADE A CAREER OUT OF A HOBBY

(Continued from page 92)

listing in "Who's Who in America."

Under his guidance a course in instruction by mail of the making of photographs for publication was prepared, and it proved highly successful. During the time he has been connected with the Institute, McKay has not allowed his work in the book and magazine fields to lapse. Today he is the author of six published text books, in addition to hundreds of articles in American and foreign magazines. His life is the story of a real success that grew out of a hobby which had been applied with intelligence and determination to solving the problem of making a living.

• • •

OLYMPIC STRONG MAN WAS PUNY BABY

JOE MILLER first saw the light of day on July 8th, 1909, in Parkesburg, Pa. If the doctor had been right, it would have been his last glimpse, as well. For he certainly didn't look strong or well enough to live. But, contrary to expectations, this puny, sick baby managed to survive—and, today, at 24, he is one of the world's foremost weight-lifters. That interval of twenty-four years represents a shining example of wholehearted persistence, firmly directed by well organized training.

When Joe Miller was eight years old, he was far below average strength, a poor match for any of his playmates. Two years later came a "blessing in disguise." Forced at ten to seek work because of straitened family circumstances, he hired out as a chore boy on a farm. So he began a life of fresh air, simple, wholesome food and plenty of hard manual labor. At twelve he had raised his physical ranking to about average for his age, and it was then that his physical ambitions started to take shape.

An advertisement in a local newspaper of a physical training course caught his eye. He sent away for a booklet and devoured its contents avidly. The scarcity of family funds prevented further action, but his enthusiasm and ingenuity was unchecked. Pending the time when he should have enough money to enroll in a comprehensive health-building and physical training course, he set to work rigging up his own apparatus. Discarded inner tire tubes were turned into chest expanders, door knobs became dumb-bells, buckets of water served as kettle weights.

At nineteen he *(Continued on page 94)*

Secrets of Success

OLYMPIC STRONG MAN WAS PUNY BABY

(Continued from page 93)

became interested in "the body beautiful." He took up muscular control and a year later, at a period when he says he was able to outwork and outlift any man on the neighboring farms, he won a posing contest, open to all amateurs.

The following year he realized his original ambition to study physical training in a thorough, organized manner. While attending a strong man show in Philadelphia he met the director of one of our best-known and most reliable physical training schools. To this man Joe Miller ascribes all his present strength and development. In fact, he goes so far as to say that this teacher is "the most astounding example of Health, Strength and Development" that ever lived!

Joe enrolled for several courses in this man's school and trained under him for three years. In 1931 he was induced into entering The Middle Atlantic Weight Lifting Championship. Men in these contests are scored on the total number of pounds lifted in three different ways—namely, pressing, snatching and jerking. Joe Miller, in his first contest, made a score of 580.

This year he won the same championship with a score of 682. At the Olympic Trials he lifted 693 pounds. Unofficially he has done as well as 710 and 720, which is pretty close to the record for his class. Leaders in any field, from weight lifting to sky-writing, get to the top and stay there because they always believe that there's more to be learned about their own particular specialty. Joe Miller's ambition is to become still stronger, better built and to further increase his weight-lifting records.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

LARGE BEVEL HELPS IN FITTING WALL BOARD

ANY home owner who is about to line his attic, basement, or garage with wall board will find the work easier if he makes a large wooden bevel-square for transferring angles accurately. The bevel is placed in the angle where the sheet of wallboard is to be fastened and is adjusted to fit exactly. Then the thumb nut

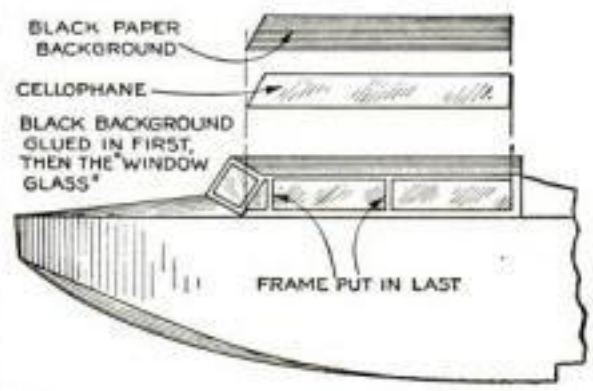
Marking wall board with a large bevel

at the joint is tightened so that the bevel may be used to mark the angle on the wall board.

The bevel may be made of oak, maple, or any hard wood. A useful size for the beam is ⅞ by 2 in. by 4 ft. 6 in., and for the tongue, ¼ by 2 in. by 3 ft. 6 in. A slot ¼ in. wide and 3 ft. 6 in. long is cut down the center of the beam, leaving 5/16 in. of wood on each side of it, and the bottom end of the slot is cut at an angle of 45 deg. Then the tongue is fitted and the joint end worked to a half circle. A 1½ by 5/16 in. carriage bolt with a thumb nut, two washers, and a lock washer is used to fasten the parts together. The end of the tongue is cut on a bevel so that it will close into the slot.

Such a large bevel may be used for other purposes in laying out work of various kinds.—C. A. K.

REALISTIC WINDOWS FOR WHITTLED MODELS



NEAT looking windows for models whittled from wood, such as the airplanes described in Donald W. Clark's series of articles, can be easily made from transparent cellophane wrappers. Carve out a space the same size as the window and from 1/32 in. to 1/16 in. deep, according to the size of the model. Then cut a piece of cellophane and another of black paper the same size as the window or very slightly larger; if they are larger, they will stay in place better while you are working. Glue the black background in the recess and put the "window glass" over it. Then glue in whatever framing for the window the model requires, or carve an artificial frame.—JOHN C. ZIMBECK.

USE BIRTH CONTROL TO RESTORE FORESTS

(Continued from page 17)

in New York, Madrid, Moscow, and other centers supplied their best species, India, Palestine, Spain, China, Guatemala, the Canary Islands—a total of forty countries—sent seed.

Then the planting began. It was not enough that one planting from the Canary Islands should be attempted. Seed from six different locations within those islands were planted in order that a comparison of seed from parents in different geographic locations, grown under similar conditions at the Institute, might be made.

Never in the past has such a test been made. Infinite pains were taken to have conditions uniform throughout the large nursery and, as a further safeguard, seeds from each source were planted in two different parts of the nursery. Each year their height, diameter, and branch measurements have been recorded and at the end of the second year the vigorous and normal growths were transplanted to the arboretum where their progress is being followed year after year. The runty seedlings were discarded.

AS SUPER-FORESTS grow before their eyes, the scientists at this novel laboratory learn that the fastest growing pine yet tested is the Monterey of California. Others among the outstanding pines are the Spreading-leaved from Mexico; the Cluster from France; the Italian Stone from Italy; the Coulter from Southern California and the Slash and Loblolly of the southern states. From one, or possibly an intermixture of two or three of these, achieved through successive generations, America's super-pine, straighter, taller, stronger-grained than any the world yet has seen, may be developed.

Meantime the Institute is producing rapid-growing races of trees and powerful individuals among those races. It collects seed from particular trees, plants them and observes the results. In a single test, seed was collected from 765 individual Western Yellow pine trees in sixty counties of twelve states; and in another were the offspring of 250 of the largest hybrid and black walnuts on the Pacific coast.

These tests revealed that within a given species appear many local strains and that trees from common parents may be weak and strong in one locality.

Here science makes the child prove whether his parent is worth perpetuating. Once the strength of the strain is determined, they go back year after year, obtaining pollen and seed with which not only to perpetuate the race but to improve it by crossing with others.

"THE ideal timber trees," Austin said, "will be a product of hybridization. They will combine, for example, the extremely rapid growth of the Monterey with the excellent wood quality of the Slash or Western Yellow pine. They will have highly efficient foliage, making for relatively few branches on the trees and a corresponding scarcity of knots in the lumber. They will have a sturdy root system.

"Possibilities for improvement are unlimited and we should be no more content to keep on using inferior wild strains of trees for reforestation than we would be to return to the original wild forms of domestic animals and plants."

But where, aside from restocking our forests, lies the value of these efforts, which will continue for several decades?

In the past we have seen grapes, peaches and other fruits developed for their shipping qualities. Just so, improved strains of timber are being bred for different uses. Bridges require wood of great strength and sturdy weather resistance quality. Box makers demand wood that takes nails without splitting. Planing mills require wood that is quickly and easily worked. Paper manufacturers want wood whose fibers are long and of good quality.

The demand for wood today is enormous. Each year the railroads use 130,000,000 ties; 5,000,000 trees are cut each year to make telephone and telegraph poles; every Sunday edition of a big city newspaper eats up the pulp wood from sixteen acres. In short, we cut 250,000,000 trees every year, decreasing the forest area 18,500 square miles.

TWENTY leading industries depend on wood as their main raw material; fifty-five others require specialized grades and qualities of lumber. Wood also is needed in the making of a long list of useful products. (See page 58). Scientists predict wood will be a future source of motor fuels.

Professor Walter Mulford, head of the Division of Forestry of the University of California, and President of the Institute's Board of Trustees, estimates that, by producing trees to reach maturity in twenty-five instead of fifty years, the cost will be cut two-thirds, or a saving of $29,900,000,000 on the nation's private and public timberlands, which total today 460,000,000 acres!

Even to cut ten years off the growing time will reduce the cost nearly half. Here are Mulford's figures, bared on five percent compound interest on an investment of $10 an acre, and they do not include costs of fire prevention and upkeep:

Acre cost at the end of 10 years	$16.29
Acre cost at the end of 20 years	26.53
Acre cost at the end of 25 years	33.86
Acre cost at the end of 30 years	43.22
Acre cost at the end of 40 years	70.40
Acre cost at the end of 50 years	114.67

So, you see, the difference between the cost at the end of twenty-five years and at fifty years is $80.81 an acre, and the saving on 160 acres to be effected by the ideal tree will be $12,930. Meantime the land will have produced two crops and two profits within an owner's lifetime.

"Four-fifths of the nation's timberlands," said Mulford, "is in the hands of private owners, and until the natural handicap of high costs is overcome there will be no general reforestation, despite such recent encouragements as tax deferments and liberal offers of stock for planting.

"Meanwhile the national timber supply is being consumed more than three times as fast as it is being replaced by new growth. Less than one-sixth remains of the virgin forests that once covered half the total area of the United States. Present overproduction makes it difficult to realize the nation is approaching a timber shortage; but even now there exists serious regional shortages in sections that once ranked high in production."

STATE and federal governments today are attempting to meet this problem, but more than 81,000,000 acres of devastated timberlands must be restored to production if a balance is to be struck between growth and consumption.

At the best rate of progress yet attained, by all the agencies combined, the task would not be completed until the year 3532! Sixteen centuries!

But now one can think in terms of forests that reach maturity in a quarter-century. Practical men can think and plan on those terms. The discovery and development of improved, faster-growing trees that fit into our scheme of economy will help largely in solving the problem of reforesting acres denuded by saw and fire.

SHATTERED MEN REBUILT BY MASTER SURGEONS

(Continued from page 32)

repair of delicate broken and injured nerves.

A little more than a year ago, a Brooklyn, N. Y., beer runner was carried to a hospital with his right upper arm shattered by bullets. The fractured bone above the elbow knit satisfactorily, but the injury left the wrist and forearm paralyzed. When the patient held out his right hand, palm downward, the wrist dropped and the fingers could not be brought up. These symptoms showed that the large nerve which winds around the arm bone had been severed by the bullets. A surgeon decided to sew the two ends of the nerve together.

As I watched him, he wiped the back of the arm with iodine and alcohol, injected pain-deadening drugs and then cut into the flesh midway between the shoulder and the elbow. Assistants rapidly stopped bleeding with gauze sponges. Pushing his way carefully through tough muscular fibers, the surgeon reached the two ends of the severed nerve. With a steady hand, he placed each end of the nerve in a special device which held it firmly but did not squeeze it. Then, with an extra-fine curved needle and black surgical thread, he sewed the tube-like sheaths, surrounding the nerves, together.

TEN months later, I had an opportunity to see the results of his skillful work. The paralysis had completely vanished. The patient could feel perfectly in his hand. All evidences of a severed nerve were gone.

When I was doing neurological work in the United States Army Medical Corps, during the World War, I saw 800 soldiers at one time who were under treatment for severed or injured nerves. Because the thin-walled tubes that form the sheaths, or insulation, for the glistening white nerves are easily torn, the work of sewing the ends together is particularly delicate. They must join exactly. The slightest pulling or strain will rip out the threads and ruin the operation. Only nerves an eighth of an inch in diameter or more are joined and even the smallest require ten stitches of the black silk to hold the sheaths until they knit.

Unlike a broken electric wire, which will carry current as soon as it is joined, a severed nerve requires months before it will function again. Below the point where it is cut, the nerve remains dead and a new nerve has to grow down through the sheath as the old one disintegrates and is absorbed by the body. The rate at which the new nerve pushes down through the old sheath is approximately an inch a month, or a little more than a foot a year.

In cases of incurable cancer, and other types of disease in which the pain is great, surgeons now bring permanent relief by removing the sensory nerve leading to the seat of the pain. As the motor nerve is left intact, control over the area is retained. Of all pain, the greatest is that resulting from trifacial neuralgia which affects the main trifacial nerve, running from the brain to the face. So excruciating is it that most sufferers either commit suicide or become drug addicts. Surgery now removes this nerve, giving the only possible relief. Afterwards, as the nerve grows in, it is destroyed by injections of alcohol within the sheath.

REPAIR work on motor nerves in the face is also important. I recall one case in which a three-year-old baby had an abscess in his right ear which broke and severed the right motor nerve that runs from the brain to the face, passing near the lobe of the ear. The child's face, as a result, was drawn far to the left. Unless the nerve could be repaired, he was disfigured for *(Continued on page 98)*

SHATTERED MEN REBUILT BY SKILLFUL WORK OF MASTER SURGEONS

(Continued from page 97)

life. In an operation that lasted nearly an hour, a surgeon joined the two ends of the nerves and, in six months, the expression of the face was again normal.

But, the most dramatic bit of nerve repairing of which I have ever heard occurred in a London, England, hospital, several years ago. A large nerve trunk had been severed in a patient's arm by a shotgun wound. Four inches of the nerve were gone, so it was impossible to join the two ends.

The surgeon learned that another patient was to have his leg amputated the same afternoon at another hospital. Telephone wires buzzed busily. As soon as the leg was amputated, it was placed in a warm salt solution and rushed by taxicab to the room where the nerve operation was being performed.

When it arrived, it was still warm. The patient was already under the anesthetic. Working rapidly, the surgeon took out four inches of a large nerve from the amputated limb and spliced it carefully to the two ends of the severed trunk in the arm of his own patient. The result of this operation was a complete success.

Thus, using living nerves and bones and flesh as the material with which he works, the specialist performs feats of reconstruction and repair. Such achievements in human carpentry, relatively unknown to the general public, constantly add amazing new miracles to the records of the operating room.

IMAGINE a man without a stomach, yet in perfect health! Next month, Dr. Damrau explains how the surgeon of today is able to remove whole organs, and restore the patient to health. It is one of the most thrilling articles of this fascinating series. Look for it in the April issue of POPULAR SCIENCE MONTHLY.

MAKING OUR MONEY LAST LONGER

(Continued from page 34)

papers for its currency. For almost fifty years, a paper finished on both sides and having a silk fiber embedded in it, has been used. Made under strict government supervision, this paper is purchased by a separate division of the Treasury Department, and held in its custody until it is needed.

An average of five and one fourth tons of it is needed each day! On it are printed over 3,250,000 currency notes, costing the government, including paper, nine-tenths of a cent each, but when placed in circulation worth over $13,250,000.

THE Bureau of Engraving and Printing is responsible for every sheet of currency paper that it draws. This comes in sealed packages of one thousand sheets, and all through the process of money making checking is continuous.

Moist paper is necessary for currency printing, and the first operation is to place the paper in wetting machines, which feed each sheet under a spray of water. Then they are wrapped in moist cloths, placed under heavy weights, and allowed to stand for three or four days, so that the moisture will sink into every fiber. When sufficiently seasoned, the sheets are delivered to the plate printers, who print the backs of the notes. Then they are returned to the Wetting Division, where they go through the same process of wetting and seasoning before the faces of the notes are printed.

Both sides printed, the sheets are fed through a machine that coats them with a sizing mixture of glue, water, and a small quantity of alum, which helps them to resist use and abuse. A later process restores the sheets to the smoothness lost in printing.

The last process is numbering and sealing. In carefully-guarded iron cages, specially-designed machines print numbers and seals, cut each sheet into the required number of notes, and count them into packages of 100.

The fact that the identifying numbers and seals must be printed on the bills as the final step in their manufacture is a serious handicap to efforts to increase the life of our currency. It makes impractical the treating of the surface of the paper, as the application of the resistive coating must be made before the final stage of production has been reached.

Each afternoon, every sheet of currency paper, and every note, must be accounted for before the 4,000 employees are permitted to leave the Bureau. The checking and accounting system used is so comprehensive that it is possible for Bureau officials to learn from their records the name of every employee who had a hand in the production of any given bill of the millions that are printed each year.

Most of us confine our interest in our paper currency to the denomination figures printed on it. Few of us realize that there are seven classes of paper money in circulation, although only five classes now are being printed and issued—United States notes, gold certificates, silver certificates, Federal Reserve notes, and National Bank notes.

It was from the United States notes, originally issued during the Civil War, that our paper money got its nickname of "greenback." There is $346,000,000 worth of this currency outstanding. At present these notes are issued in denominations of $2 and $5 only. Gold certificates are issued in denominations of from $10 to $10,000—the latter being our highest-priced piece of paper money. Silver certificates range from $1 to $100. Federal reserve notes start at $5 and go up to $10,000. National Bank notes at present are being issued in denominations from $5 to $100.

Some Treasury notes of 1890, and some Federal Reserve bank notes still are in circulation, but they are being retired and destroyed as rapidly as they are presented for redemption. It is odd that there are $1,250,000 dollar bills of the issue of 1890 still outstanding, although none has been placed in circulation for over thirty years. The only plausible explanation of this record-breaking longevity is that they are being hoarded.

The change to the present small sized currency was talked of for twenty years before it was made. Decided on, it was delayed by a change in the administration. Decided on again, it was held up by the World War. It was decided on for the third time early in January, 1929, and the date of issue set for July 10 of that year.

MAKING the change was a back breaking task for the Bureau of Engraving and Printing. Director Hall says that it gives him a headache just to remember it. But after a couple of months of steady effort, everything seemed to be going smoothly—until it was found that the new numbering machines wouldn't work. After weeks of feverish effort, they were adjusted and printing began. The initial issue was 158,500,000 sheets—702,000,000 notes! And every note had been delivered to the banks in time to go into circulation on July 10!

KEEPING YOUR RADIO FREE OF NOISES

(Continued from page 61)

interference before it has a chance to reach the inner wire which connects the antenna to the receiver. To be effective, the shielding must extend over the entire length of the lead-in, from the antenna to the receiver.

A shielded lead-in, however, may cause an appreciable loss in signal strength, especially when the wire is unavoidably long. It also tends to broaden the receiver antenna selectivity.

To meet the demands for a carefully designed, low-loss, interference-free lead-in, radio engineers have devised special antenna systems consisting of a shielded lead-in wire and two impedance matching transformers.

One of the transformers is placed at the antenna and is connected to the antenna wire. The second transformer is placed at the receiver and connected to the ground and antenna binding posts and the shielded lead-in is connected between the two transformers.

THE antenna transformer, being a voltage reducing device, lowers the voltage and reduces the loss in the lead-in. When the signal reaches the receiver transformer it is boosted back to near its original value. The two transformers greatly reduce the transmission losses and make it possible to use a shielded lead-in without any appreciable loss in signal strength.

One system of this type uses a receiver transformer having two impedance taps. One tap is used for matching receivers having a low impedance input circuit and the other tap serves for receivers of the high impedance variety.

With these lead-in systems, the placing of the antenna is no longer a problem. It can be arranged for best interference-free results regardless of the location of the receiver. The lead-in insures against interference entering the circuit between the antenna and the antenna binding post at the receiver. Although best noise-free results are obtained when a perfectly shielded receiver is used, the shielded lead-in measurably improves reception with any receiver.

Equal in importance to the antenna system and receiver is the ground. The temptation, when installing a receiver, is to connect the ground wire to the nearest water pipe without considering the path the pipe takes before reaching the actual ground. If it is convenient and does not necessitate a long lead, run the ground wire to a point where the water pipe enters the cellar wall.

Loose ground connections are always a source of noise. Unless the pipe to which the ground is connected is scraped clean, down to the shiny metal, corrosion is bound to set in and the receiver will develop queer scratchings that will spoil reception.

FIND FOOTBALL MOST STRENUOUS OF GAMES

FOOTBALL demands more exertion from a player during the sixty minutes of a game, than any other of a large number of sports and forms of exercise, according to a recent investigation at Harvard University. Blood tests made on members of the Harvard football team before, during, and after games showed the effect of their tremendous output of energy by the rise in the number of white cells in the blood. These cells, which combat fatigue, were shown to be called forth almost solely by exertion, and not by excitement, as some experimenters formerly believed; tests on excitable spectators showed no similar oversupply of white corpuscles, while athletes exhibited as great a profusion after practice scrimmages as following the play before a packed and cheering grandstand.

DON'T STARVE YOUR CAR'S BATTERY

(Continued from page 62)

a long trip," Harry asked, after instructing Gus to put in a rental battery and a new set of battery cables.

"Sure, you can reduce the charging rate in most cases," Gus agreed. "But the easiest way is to burn your lights when you go on a long drive. The additional drain will prevent over charging."

"But I thought every car generator had a cut-out that switched the generator out of the circuit when the battery was charged," Cummings objected.

"Generators have cut-outs, but they don't work that way," replied Gus. "Cut-outs are automatic switches that cut the generator out of the circuit when the car is running so slowly that the generated voltage is less than the battery voltage. On most cars, the generator begins charging at twelve miles an hour and decreases at twenty-five miles an hour."

"Well how can a punk mechanic like me tell when his electrical system is working as it should?" Harry inquired as he watched Gus lift the rental battery into place. "If most of the drivers in the world are as dumb as I am, they never think twice about the battery, much less the generator."

"THAT'S that way with most car owners," Gus chuckled. "It's a case of out of sight, out of mind.

"It's a cinch to check up on your generator. All you've got to do is make use of that ammeter on your dashboard. With the motor off and your lights on, jot down the reading of the ammeter. Of course, it will show on the discharge side of the dial.

"Then with your car running at fifteen miles an hour and your lights off, take a second reading. This should show on the charge side of the meter. When you compare both readings, the second one should be a little more than the first. Most generators are adjusted to give their greatest output at fifteen or twenty miles an hour so by making the test at that speed you get the greatest value."

"Sounds easy enough," Harry agreed, "but what I want to know is how I could have located that short before anything happened."

"Well, in the first place," explained Gus, "you ought to take better care of your battery. A battery coming from the manufacturer is as perfect as it can be made and if it gives up before its usual span of life you can charge it up to neglect on your part.

"A battery is just like a human being. If it doesn't get enough food, it gets weak; and if it gets too much, it gets sick. Most battery troubles can be traced to neglect—lack of water, undercharging, or overcharging."

BY THIS time, Joe Clark had returned and was helping Gus connect the new battery cables.

"The best way to take care of a battery," Gus continued as he took the wrench Joe handed him and tightened one of the battery terminals, "is to do it periodically. Test your battery every two weeks with a hydrometer. In order to make it a habit, do it on the first and fifteenth of every month. If a cell reads much below 1.250 on two successive testing dates, get the battery tested at a service station.

"Always test all the cells to make sure each one is healthy, and most important of all, don't add anything but distilled water."

"But, Gus," Cummings interrupted, "the solution in a battery is made up of water and acid, isn't it? How come you don't have to add some acid now and then?"

"If the battery is in good condition," Gus replied, "the only reason for losing any solution is evaporation, and the acid doesn't evaporate. All you've got to do is replace the distilled water to keep the solution at the proper strength. Of course, if you lose some of the solution through a leak, you'll have to add acid and water accordingly.

"Speaking of leaks," continued Gus, "any leaks in your electrical system will drain your battery too and make it weak. So besides testing the battery periodically you should test your wiring as well."

"Isn't there some quick way to test the whole system for short circuits?" Harry asked.

"There is, and it's almost as simple as checking the air in your tires," said Gus as he reached for a file. "Joe and I can show you how in a jiffy."

THE two garage men busied themselves with the headlights and cowl lamps as Harry Cummings looked on.

"The first step is to turn on all your lamps and remove the bulbs," explained Gus as he worked. "Then disconnect one of the battery cables and hold one end of a coarse file against the free terminal post on the battery, like this. Next, rub the unconnected cable end along the file. If sparks are noticed, there's a ground in the wiring. From the looks of this," Gus said indicating the absence of sparks on the surface of the file he was holding in his left hand, "I'd say that those new battery cables fixed up the only short you had. You know, every short won't be as easy to find as the one that caused your trouble, but nine-tenths of the shorts that are found in cars are caused by worn-out battery cables.

"And there's one more thing," Gus added. "If you do much driving in real cold weather always start the motor before adding the distilled water.

"Water floats on acid, you know. So if you pour it in and let it stand, it may freeze. Running the motor fast enough to charge the battery, however, makes the solution circulate around. Once the water has mixed with the acid there isn't much danger of freezing. Of course, in very cold weather, it's sometimes wise to keep the specific gravity of the solution up to 1.275."

"There's more to this battery business than I suspected," Cummings confessed as he waited for Joe to slide back the doors of the garage.

"Just remember one thing," Gus called. "Your battery is probably all right when you buy it and you can keep it that way for quite a few months if you'll only take moderately good care of it."

LOUD VOICE TO SHOUT WARNING TO SAILORS

A GIANT voice booming "Partridge Island! Partridge Island!" may soon help guide fog-bound mariners across the Bay of Fundy to a safe harbor at St. John, New Brunswick. Development of a talking fog signal, to be installed experimentally in the Partridge Island Light at the harbor entrance, is announced by J. C. Chesley, inventive Canadian marine official who originated the idea. The voice of the robot device, now being worked out at a marine appliance factory, will be produced by a steel phonograph record and projected with the aid of powerful amplifiers so that it may be heard for miles. If the signal proves successful, as recent advances in the amplification of sound suggest, the present system of identifying a station by the number and timing of blasts on a siren may be outmoded; it is expected that the spoken word will be more easily understood.

MOVIE AMATEURS USE CLEVER TRICKS

(Continued from page 29)

From the miniature workshop where Knoblock and Babb were filming their masterpiece, I went to the studios of other amateurs, whom I found using many clever devices in their effort to achieve professional effects.

One unusual project was the filming of "Black Revenge!"—a sound picture made by Fenton Earnshaw, a Los Angeles university student. All scenes were taken outdoors, and the actors were directed not to face directly into the cameras, to avoid possible lip-reading by the audience. The dialogue and sound effects, added later, were so successful that professionals who saw the picture were amazed.

A BIG-GAME hunting comedy, "Africa Squeaks," had just won W. J. Seaman a prize in an amateur contest. In this film, shot chiefly in a nearby dry river bed, with some wild animal shots from a zoo, a gorilla pursued actors through many amusing scenes, and acting almost human, performed incredible feats. Seaman let me into the secret by showing me a home-made gorilla suit, with body made from a bearskin rug, and head, which was almost unbelievably realistic, moulded from rubber. The mouth, which could be opened or shut at will, had a full set of rubber teeth, carved with a sharp knife.

One scene where the gorilla leaped from the ground into a tree, was faked simply by having the gorilla jump down from the branches, while the camera was cranked in reverse. In another, the hunter, while reading in his correspondence course on big-game hunting the chapter on "The Good and Bad Habits of an Ostrich," repeatedly had his cork helmet knocked off by an ostrich which looked out of a bush to read over his shoulder. The ostrich head was in reality a dummy, made so as to be slipped like a glove over the arm of a person concealed in the bush.

To make dolly shots, in which the camera, starting from long shot position, is wheeled toward the actors to make a close-up of an individual who is speaking, cameramen at the University of Southern California have been using a dolly improvised from a rubber-tired toy wagon, with an upright post to which the camera is screwed. The cameraman mounts the wagon and applies his eye to the finder, while his assistant, grasping the wagon-tongue, pushes the dolly forward for the close-up.

ALTHOUGH some amateurs shoot their pictures as they go along, trusting to luck and dexterous assembling to make the story come out right, the more experienced, with an eye to economy, organize their production methods. The story is broken down into its constituent shots, scenes taken with the same settings being grouped. Each shot is analyzed to get the best possible camera angle and sequence of action.

Then friends and members of the family are drafted as principals and extras, rehearsed in their parts, and actual shooting done, frequently with the producer acting as director, cameraman, prop boy, script girl, and even doubling for a member of the cast.

Developing and processing, usually done by the film manufacturer, is followed by cutting and editing. The film is inspected with the aid of a strong light, or by actual projection, and critical eyes determine where each bit of action should begin and stop, applying the scissors to this purpose. The sections of film are pinned up on a clothesline, coiled and hung on nails, or rolled tightly and tucked into the compartments of an egg box, each with a number to identify the shot. Titles are then inserted at necessary points to explain details of the plot, *(Continued on page 102)*

A definite program for getting ahead financially will be found on page six of this issue

MOVIE AMATEURS USE CLEVER TRICKS

(Continued from page 101)

and the bits are spliced together with cement.

Many are the ingenuities practiced to break the monotony of the subtitles. Usually the desired information is printed upon a black card, which is then set up before the camera and photographed. By rewinding the film and shooting another scene on the same negative, the words may be superimposed upon a background of action.

Another stunt is to use individual paper letters, arranged on a flat board with the camera above in vertical position. A few feet of film are shot on the title, with reverse camera cranking, then a vacuum cleaner hose sucks away the paper letters. When the film is projected the letters seeming appear out of space and form themselves into the completed title.

Still another method is to write the letters in wax on a metal sheet, then to pass a candle underneath, melting the wax and rendering it invisible. This process, too, is photographed in reverse so that the film shows the letters materialize out of the air to spell out the title.

BITS of film cuttings saved from old pictures often provide needed bits of action. An exceedingly clever example is a feature produced by F. B. Skeele, a Los Angeles amateur, under the title of "Bear Hunt to Africa." The plot concerns the adventures of his two small sons on a mythical bear-hunting trip to Africa. Subtitles are in the form of notes being written as they relate their experiences on their return.

Although the picture is 400 feet in length, only ten feet were shot especially for the story, all the rest being pieced together from odds and ends of film at hand, and cleverly joined together by a continuity written for the purpose. Amusing sequences include "THROUGH THE SHARK-INFESTED WATERS OF THE SOUTH SEAS"—a series of close-ups of goldfish in the aquarium; "ALL LOS ANGELES TURNS OUT TO GREET US ON OUR RETURN"—pictures of a parade in honor of a returning football team; and a final close-up of the trophies of the hunt—a large teddy bear, with a slingshot, their weapon, on the ground beside it.

About 300 amateur movie clubs are scattered over the United States. Southern California alone has an estimated 25,000 amateur movie-makers. Foreign countries, too, have their Little Hollywoods, with England and Japan foremost.

NEWS WILL BE FLASHED ON ENGLAND'S CLOUDS

SOON Englishmen may read a sky newspaper. Plans have been completed to project news articles in condensed form upon London's evening clouds, with the aid of powerful searchlights. The projectors are of the type used successfully for skywriting advertisements, and these will continue to be interspersed with the news broadcasts. When the clouds hang at a level of about 2,000 feet, the sky messages are expected to be visible to millions.

FIND DESERT SNAKES "SWIM" UNDERGROUND

STRANGE snakes that "swim" underground, in the soft sands of California deserts, have been observed by Dr. Walter Mosauer, California zoologist. Streamlined heads and bodies permit them to disappear with amazing swiftness, and to propel themselves along just below the surface of the loose sand, thus giving the suggestion of swimming exactly like fish in water.

RIDING THE NIGHT PATROL WITH THE RADIO POLICE

(Continued from page 15)

watched things pop in this round tower room with its guilded doors. Perched on the roof of police headquarters, it is the heart of the radio patrol. Direct lines connect it with the other stations. The WPEG announcer, ordinarily sends out the alarms from all three stations, one after the other, repeating each announcement twice. But in an emergency, men on duty at WPEE and WPEF can broadcast calls independently. At all stations, the tubes are kept burning continually so there will not be an instant's delay getting on the air.

BETWEEN the arms of a huge U-shaped table, covered with an enlarged map of the city, stands the dispatcher, recording the movement of the cars. Red and green cords, tacked in place, divide the map into precincts and districts. Above the sector patrolled by each car is a round brass checker with two domino dots and the number of the machine indented in each side. On one side, the number and the dots are black; on the other, white. The checkers are white-side-up when cars are on patrol; black-side-up when they are making a run. This system prevents giving a car a second call before it finishes a first.

When a machine is out of service for radio repairs, a brass ring is placed around its checker until it returns to patrol. If the car is stopping for gasoline or oil, the checker is placed on edge inside the ring. If the machine is out of service indefinitely from a crash, the checker is removed and the ring is left in its place. The crash hazard is greatest in winter when motorists have their windows up and may fail to hear the siren. But streetcars, as a hair-raising experience later that night taught me, are worst of all. A motorman, in a rattling car with the windows up, rarely hears a siren until the radio cars are virtually on top of him.

For more than an hour, we patrol back and forth, then pull up at the curb before a restaurant. There is a lull in the activity of the loudspeaker.

"All quiet on the western front," grins Waldron as he climbs out for a cup of coffee and a sandwich. The others join him while Dolan and I stay in the car.

Five minutes go by. Suddenly, the loudspeaker jumps into action:

"Calling cars 1214, 1215, *65*. Go to 2090 Broadway. Signal 31."

Dolan jots down the address and I jump to get the other men. They come on the run. As the car lurches ahead, they are still complaining about the acres of half-eaten sandwiches and the lakes of coffee they have left in restaurants.

THE siren is screaming. We are weaving in and out of dense traffic. A motorist ahead slams on his brakes. We miss clipping him by inches.

The lights are with us and we touch sixty miles an hour. Traffic ahead clears at the sound of our siren—all except a coupe containing a man and a girl. It sticks to the middle of the road until at the last second, the driver hears the siren and scoots for the curb. Kennedy growls: "There ought to be a law against men and women riding in the same car."

Then the siren stops. It is always shut off at least four blocks short of the destination so crooks will not be warned. We grind to a stop and see the two precinct machines parked at the curb. Kennedy snorts: "Look at those Dolly cars. They're thick as gnats. They get in your eyes."

Upstairs, in a beauty parlor, the chalky-faced manager is *(Continued on page 104)*

Riding Night Patrol With Radio Police

(Continued from page 103)

relating how he was counting the $250 in the cash register, when he heard someone coming down the stairs. The week before, a fire had cleaned out the floor above, leaving it open to any thief who climbed the fire escape. He had run around, seen two legs disappearing up the stairs, and had phoned for the radio cars.

With the big searchlight held away from his body, Dolan mounts the steps. The others follow, right hands in outside pockets. For fifteen minutes, they comb the upper floors and the roof. Then they come down. The frightened thief apparently scuttled down the fire escape and made his getaway before the manager had finished sending in the alarm.

EVEN when a crook escapes, the speed with which the radio cars swoop down on the spot he has just left, makes him pause before taking another chance. Every radio alarm means a close shave for an escaping criminal and is a deterrent of crime. Again, the split-second arrival of the cars often stops a quarrel before it reaches the murderous stage.

The biggest haul made by the New York patrol was a $15,000 silk truck; the smallest a five-cent package of gum. The latter capture resulted from a broadcast that someone was crawling in the fourth story window of a candy factory. Detectives collared a ten-year-old boy who had scaled a six-story building next door to enter the factory in search of sweets. All he had found when the police arrived was a package of gum.

Last summer, an epidemic of false alarms was traced to a nineteen-year-old boy. On the day the crew in Sixty-five caught him, he had called the radio cars, an ambulance, and the fire department to the same corner at the same time.

Whether a call is a false one or a "heavy beep," it is always handled with the same care. For, Dolan tells me, a maxim of the service is:

"The call you get careless on carries the wallop."

As we are rolling back downtown, the metallic voice of the loudspeaker announces:

"The time, 11:30 P.M. The time, 11:30 P.M. Station WPEG. Station WPEG."

ON EVEN and half hours, the time is broadcast as a check upon the radio sets. If half an hour goes by without a time signal coming through, the man in charge of a car calls headquarters and a radio repairman is dispatched to examine the set. These high-speed trouble-shooters ride in light, blue-green trucks fitted with testing equipment, tool-boxes, spare sets and batteries.

A little after midnight, I see another nerve-tingling phase of the patrol work—stopping suspicious cars and searching them for guns. A car with six men in it, and its motor running stands at the curb in front of an all-night restaurant.

"They don't look so good. Let's give them a toss," Waldron suggests. Dolan nods. Sixty-five slides noiselessly abreast of the other machine and then cuts in at a sharp angle ahead of it. A metal plate tinkles against the windshield. It is labeled POLICE to keep the detectives from being mistaken for bandits.

Before the wheels of Sixty-five stop rolling, the men are surrounding the other car. Dolan is courteous, but takes no chances. After the occupants are searched, the men look under the seats and even lift the hood. The latest ruse of the underworld is a compartment hidden under the seat or hood of a car for holding guns. One machine, captured by Sixty-five, was equipped with a fake radio, all wired up, holding three revolvers.

Since the start of the patrol, Dolan and his men have taken eighteen guns. Only a few nights before, they got five at once when they stopped a bandit car containing four men with a record of twenty-three stick-ups. All were armed and one had two guns, one up his sleeve.

IT IS after one A.M. when we swing past a blood-red neon sign before a drug store. It was here that the "Baby-Killer Bandit," Vincent Coll, was riddled by gangland bullets as he talked in a telephone booth. We are heading north again, when the attention note screeches overhead:

"B-e-e-e-p! Calling cars 1206, 1207, *65*. Holdup at garage at 401 Ninth Avenue. SIGNAL THIRTY."

"That's the same garage where the Coll mob kept their car," volunteers Salamone as we swerve into a side street and race across town. We are only four blocks away and Kennedy cuts in under the elevated and jerks to a stop in the doorway of a low garage, painted green and yellow. The other cars have not arrived.

A few minutes before, two men had walked briskly into the garage, shoved automatics into the stomach of the negro washer in charge, locked him in the office and sped off in a yellow roadster just left by a customer.

"We'll hear from that baby before the night's over," predicts Waldron. Almost every big holdup, nowadays, is preceded by an auto theft to provide for the getaway.

Dolan is taking the number of the stolen car from the office record-book. He puts in a quick call to WPEG. The negro washer

This transmitter is the heart of the radio police service, as it sends out all orders to the 300 cars

is badly frightened and he keeps wailing: "Now I got to call up the boss and tell him the car's gone."

We are dashing for Sixty-five as the Dolly cars wail up. The bandits have headed south and far ahead, we see a car flickering in and out of the street lights. It is traveling at high speed. Before we can close the doors, Kennedy is jerking the car around.

AS WE gain speed, over the loudspeaker comes the message describing the car and giving the license number. Only thirty seconds have elapsed since Dolan finished phoning in this information, yet, already, every machine on the radio patrol has been warned to keep a sharp lookout for this car.

Elevated pillars, black and white, are streaming by. For twenty blocks, they form a narrow lane of steel. We seem racing down a tunnel, the rows of pillars on either hand, the dark tracks of the elevated overhead and beneath, the gleaming, slippery rails of the surface car track. The slightest skid will rocket us into the pillars on either side.

Everything is deathly still inside the car. The speedometer hand is rising higher and higher. The tiny red dot of the other car's tail-light is slowly growing larger. We are gaining.

Two blocks away, we suddenly catch a glimpse of a streetcar bumping across town with its windows closed. Unless the motorman hears us, his pace will carry him directly in our path. On the slippery rails, we cannot stop. Hemmed in by the steel pillars, we cannot swerve to either side.

The high-pitched siren is screaming at the top of its voice. Only when the blunt green nose of the trolley has actually poked past the left-hand line of pillars does the motorman hear us and slam on the brakes. I catch a fleeting glimpse of his scared white face as we streak by.

At every block now, the car ahead is growing in size. We can see it is a light-colored roadster. All around me, the men are leaning forward, right arms bent, hands sliding into revolver pockets. Suddenly, the roadster slows down and swerves into a side street, angling to the left. The men have their hands on the doors, ready to jump. We are closing in. The moment has all the tense menace of going over the top at the zero hour. For these men, it's always this way. One ride with the radio patrol, and your respect for the police increases a hundred percent.

THE yellow roadster zips under a street-lamp. A white face peers back through the rear window. Two black streaks shoot from the car into the weeds of a vacant lot. Cornered, the bandits are getting rid of their automatics. A moment later, their machine tries to twist into a side street at high speed. It careens on two wheels, slices past a lamp-post, bounces, out of control, over a curb, crashes at an angle into a brick wall and grates to a stop.

A short man in a gray coat leaps from behind the wheel and races for an alley. The men are tumbling out of Sixty-five, guns in hand. Dolan's roar: "STOP!" carries for two blocks. The running man flashes a look back over one shoulder and halts, hands in air. The game is up. His companion, knocked out by the crash, is coming to. Expertly, Dolan and Salamone go over them for other weapons. From the loudspeaker comes a calm voice:

"The time: 2:01 A.M."

Waldron, with the searchlight, goes back for the discarded automatics. When he returns, the two bandits are being piled into the rear seat with Dolan and Salamone. I climb in front with Waldron and we head for the nearest precinct station.

Later, when the men were shaking hands with me at the end of the tour, Dolan remarked a little apologetically:

"Well, I'm afraid it's been a pretty tame night."

I stared at him. He wasn't joking. He meant it. For, to these riders of the night patrol, drama, action, color, thrills are just part of the job. Their's is a hazardous business, a nerve-tingling game. But it is more than that. By combining courage with science, their work is bringing about a new era in police methods, a split-second efficiency which means greater protection for the public.

A SISTER SPEAKS OUT — by Timins

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